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BULLETIN NO. 10—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

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PREPARED UNDER THE DIRECTION OF
L. O. HOWARD,
ENTOMOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

DIVISION OF ENTOMOLOGY.

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Artist: Miss L. Sullivan.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., December 15, 1897.

SIR: I have the honor to transmit herewith the manuscript of a bulletin which contains matter comparable to that contained in No. 7 of the new series, viz, miscellaneous articles, reports and notes which are difficult to classify, but which deserve prompt publication. I therefore recommend its publication as Bulletin 10, new series, of this Division.

Respectfully,

L. O. HOWARD,
Entomologist.

HON. JAMES WILSON,
Secretary of Agriculture.

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INTRODUCTION.

The present bulletin is the second of those belonging to the new series which contain shorter articles and notes; in fact, such material as was formerly published in Insect Life. It is the policy of the Division to present in this form the results of the observations made in the office which are not sufficiently extensive upon any one topic to form an independent and complete bulletin. The present issue contains a number of articles which will doubtless be found of wide interest and more or less importance. The article upon the peach twig-borer, by Mr. Marlatt, was completed in July, and was presented by title before the meeting of the Association of Economic Entomologists at Detroit, Mich., in August. A bulletin by Mr. Cordley, of the Oregon Station, which has priority of publication, was apparently prepared simultaneously with this article. It is hoped that the article by the writer on the fig-eater, or green June beetle, will be of value as showing the harmless character of the larvæ of this insect, which have generally been supposed to be plant depredators of some consequence. The series of articles by Mr. Chittenden comprises a number of new notes upon garden insects which have resulted from a series of careful observations upon insects of this class. Further results will be published from time to time. The articles by Dr. Zehntner, of Java, and Professor Matsumura, of Japan, have an interest to American economic entomologists, not only from the general interest attaching to the methods of work in economic entomology by trained foreigners, but also from the fact that the necessity of an intimate knowledge of foreign species which may at any time be introduced into our territory, is every day becoming more evident.

For a number of years it has been thought very desirable to have an annual exploration made of the territory comprised within the limits of the permanent breeding grounds of the Rocky Mountain locust, as well as the adjoining territory, for the purpose of obtaining exact knowledge of conditions upon which might be based some intelligent idea as to the prospects of locust abundance in ensuing seasons. These annual trips have always been made down to the present year by Prof. Lawrence Bruner, of the University of Nebraska, under the auspices of this Division. Thus Professor Bruner's reports for 1895 and 1896 were published in Bulletin No. 7 of this series. In 1897 the newspaper reports and the office correspondence indicated a greater abundance of

grasshoppers than usual, and in Professor Bruner's absence in South America his assistant and former companion on some of these trips, Mr. W. D. Hunter, also of the University of Nebraska, was commissioned to undertake the work. Mr. Hunter's report is published in full, and it is gratifying to note that although the true Western migratory grasshopper was, owing to conditions which he has pointed out, more abundant than for several years past, the character of the season of 1897 was such as to suggest the probability that the numbers of this insect will be much less during the summer of 1898. The articles by Mr. Coquillett present synopses of the species of the insects known as black-flies, or buffalo-gnats, and on the habits of the injurious flies of the families Oscinidæ and Agromyzidæ, and will have an interest by no means limited to the systematist. The accurate knowledge gained from the view of the habits of the last-named families will be of especial value to the economic worker particularly interested in the insect enemies of grains and grasses.

L. O. H.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

THE PEACH TWIG-BORER.[1]

(*Anarsia lineatella* Zell.)

By C. L. Marlatt.

INTRODUCTION.

Up to the present year the twig-borer of stone fruits and the crown-miner of the strawberry have been treated as the same insect, as indicated in the appended bibliography and as will be fully explained later.

Prior to the observations made by Mr. E. M. Ehrhorn, as published by Mr. Alex. Craw, the knowledge of the twig-borer was confined to the fact of its injury to peach twigs, either in terminals before the trees leaved out in the spring, as described by Glover; or in the young shoots and later in the ripening fruit, as described by Professor Comstock and others. What was supposed to be the same insect had also been observed to affect the crown of the strawberry, as reported by Mr. William Saunders and later by other writers, one brood wintering in the half-grown larval stage in the crowns and a second brood working during early summer in the young shoots and runners.

While passing through California in the fall of 1896 the writer had the pleasure of meeting Mr. Ehrhorn and examining with him the curious hibernating chambers made by the newly hatched larvæ of this insect in the crotches of the trees and had explained the habits of this insect as far as then known to Mr. Ehrhorn and substantially as recorded by Mr. Craw. The discovery of this peculiar hibernating habit of *Anarsia lineatella* is very interesting in itself, and is also a long step toward the completion of our knowledge of the life history of the insect, and is especially valuable as suggesting better means than any heretofore known of preventing damage from it.

Arrangements were made with Mr. Ehrhorn at the time to supply the Department with ample material of the young larvæ in their hibernating cells; and, throughout the winter and spring of 1896–97, Mr. Ehrhorn was good enough to send repeatedly quantities of such material

[1] Read by title before the ninth annual meeting of the Association of Economic Entomologists, August 13, 1897.

for study to Washington. Later in the year, after the larvæ had abandoned their hibernating chambers, Mr. Ehrhorn supplied us with partly developed larvæ in the terminals of the twigs, and still later pupæ, together with field notes supplementing or confirming our breeding records.

Some of the twigs containing the young hibernating larvæ were, during the winter, fastened to peach trees growing in the entomological nursery attached to the insectary. Most of the larvæ in these twigs had been killed by a predaceous mite, and some few, perhaps, died as a consequence of the drying up of the twigs, but a considerable number of them wintered safely and ultimately entered the new shoots in the early spring and completed their development. With this material we were enabled to study their habits out of doors under natural conditions, following the species carefully through two generations and into the commencement of a third, as will be detailed below. By the end of August our working stock died out and we were unable to secure fresh supplies. The material was taken care of and notes were kept for the most part by Mr. Theo. Pergande, to whose skill and care is due much of the success of the breeding experiments.

Mr. Craw's report of the facts discovered by Mr. Ehrhorn is in the form of a brief note, and at the wish of Mr. Ehrhorn the more careful investigation of the insect herewith presented was undertaken by this Division. After the completion of the MS. of this paper the account of this insect by Mr. A. B. Cordley was received (Bul. 45, Oregon Exper. Station[1]), which is chiefly interesting as confirming the belief that the twig-borer and the strawberry crown-borer are probably distinct insects.

ORIGIN AND DISTRIBUTION.

The twig-borer is apparently an Old World species, and probably a very ancient enemy of the peach, with little doubt coming with this fruit from eastern Asia. It was described in Europe by Zeller in 1839 and in this country by Clemens, as *Anarsia pruinella*, in 1860. Clemens's species was afterwards shown to be identical with the European *lineatella*. As an important injurious insect in this country, attention was first drawn to it about 1872 by both Glover and Saunders, the report of the former being the first published. Glover's report describes excessive damage by it as a twig-borer in young peach orchards in Maryland, and Saunders's report, while relating chiefly to marked injury by a crown-borer in strawberry beds (now known to be a different insect), refers also to injury to the peach twigs in Ontario. Considerable damage from the true twig-borer was reported some years later by Prof. J. H. Comstock as occurring in Virginia and in the District of Columbia, in connection with which the peculiar fruit-inhabiting

[1] The substance of this paper, with some additions, was republished in the report of the proceedings of the ninth annual meeting of the Association of Economic Entomologists (Bul. No. 9, n. s., U. S. Dept. Agric., Div. Entom.).

brood is first recorded. Later the insect was made the subject of an article by Dr. J. A. Lintner, in which it is reported to have occasioned damage to peaches in several localities in the State of New York. We also have accounts by Prof. C. V. Riley of injury to strawberry plants in Illinois, referred by him to *Anarsia lineatella*, and also articles on this insect particularly as a strawberry miner by Prof. S. A. Forbes. Very great damage to peaches in Kent and Sussex counties, Del., is later reported by Riley and Howard.

On the Pacific slope record is made of injury by it to various stone fruits by Mr. Coquillett, and later similar damage is reported in a letter from Mr. Knight, of Vancouver. We have also the results of the investigations by Mr. Ehrhorn in California, reported by Mr. Craw, and the recently published account by Mr. Cordley relative to the insect as affecting peaches and prunes in Oregon, and also in strawberry beds—a similar but undoubtedly distinct insect.

In addition to these more important published accounts, injury from the twig-borer has been often recognized and reported in later years. Nearly all these reports refer to the injury to twigs of stone fruits and very few to damage to strawberries, the strawberry-infesting insect either being more rare or less often observed. The records of this Department show the presence of the twig-borer in at least twelve States, and give a range which indicates that it is practically as widespread in this country as is the culture of its principal food plant.

If not already cosmopolitan in distribution the twig-borer is rapidly becoming so, and will probably follow the peach and other stone fruits wherever they are cultivated, especially as its peculiar hibernating habit greatly facilitates its distribution in nursery stock.

It is at times a very injurious insect, and is often notably abundant and destructive in such important peach districts as those of Maryland, Delaware, and Virginia. In California and elsewhere on the Pacific slope its injuries have a wider range, including, as indicated, the apricot, almond, nectarine, prune, pear, and perhaps other fruits, in addition to the peach. In California it is listed as one of the three or four worst insect pests occurring in the State. In Washington as many as 100 larvæ, or instances of damage to as many twigs, have been counted on a single tree.

HISTORY AND HABITS.

The fall brood of larvæ discovered by Mr. Ehrhorn may be taken as a convenient starting point in the life history of the twig-borer. In the fall, as reported by Mr. Ehrhorn (Craw), they appear as very small larvæ, living and working in the spongy bark chiefly at the crotches of the branches of the peach, and he surmises that they are from eggs deposited in these situations. Here the larvæ are supposed to grow slowly until the new growth appears in the spring, when they leave their cells in the bark and enter the new shoots. It is stated, also, that frequently the larvæ are nearly full grown when they attack the

young growth. The later brood is said to attack the fruit near the stems. The occurrence of the larvæ during the winter in the situations noted is also thought to explain the fact frequently noted that the under and inside twigs, being the more accessible, suffer the most, while the exterior and topmost branches escape.

Our later studies confirm, in the main, Mr. Ehrhorn's conclusions as to the habits of the larvæ. That the larvæ make any essential growth in the winter, however, is probably a wrong inference, as will be shown later, and the nearly full grown larvæ referred to were doubtless individuals that were wandering from one point to another, and had merely reached nearly full growth before they were observed.

Both in the orchards of California and by means of the abundant material received at this office we have been enabled to make a careful study of the hibernating galleries or chambers of the young larvæ. These occur not only in the crotches of the smaller and sometimes quite large branches, but many of the larvæ utilize the roughened bark at any point. They burrow into the bark for a short distance, penetrating little more than the upper superficial layer, and form slightly elongated chambers (fig. 1 *c*), which are lined with white silk and the opening afterwards closed. The location of the larvæ may be readily recognized by the little masses of projecting excrement or comminuted bark at the entrance to the burrows (fig. 1 *a*, *b*). The size of the burrow and the fact of its being lined with silk precludes the idea that the larvæ feed in the fall or during hibernation, except perhaps in the mere operation of excavating the chamber.

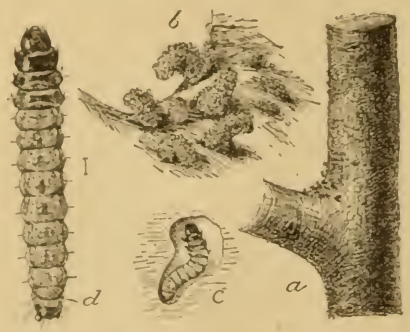

FIG. 1.—*Anarisa lineatella*: *a*, twig of peach, showing in crotch minute masses of chewed bark above larval chambers; *b*, same much enlarged; *c*, a larval cell with contained larva, much enlarged; *d*, dorsal view of young larva, more enlarged (original).

The young larva, as taken from the burrow, is not above 2 millimeters long, and is of a general yellow color, with the head and cervical and anal plates dark brown, almost black (fig. 1 *d*).

While in their winter quarters the larvæ are subject to the attacks of predaceous mites, and many of them are destroyed by this means, as will be later noted. They are also occasionally parasitized by a chalcidid fly.

Early in April the larvæ begin to abandon their hibernating quarters and attack the new leaf shoots, but some individuals were found in the crotches by Mr. Ehrhorn as late as April 21. The damage becomes noticeable, as a rule, at the time the shoots are from one-half inch to 2 inches in length, or, more properly speaking, mere clusters of newly expanded leaves.

Glover's account of their working downward in the old twigs from the terminal buds before the starting of the leaves in April apparently can not be questioned, but seems not to be the normal course, as shown by the observations since made.

In our experience, the larvæ begin to migrate only after the new foliage has begun to put out, and they attack the new shoots at any point, generally, however, from one-half inch to an inch from the apex, either near or in the crotch formed by the leaf petiole and the stem. The longest burrow observed was 1½ inches and the shortest one-fourth inch. Sometimes the burrow extends about one-eighth inch above the the entrance, and occasionally the larvæ simply eat into the shoot as far as the pith and then go elsewhere. The larvæ are seemingly restless and not easily satisfied, and are continually moving from one shoot to another, and are most active travelers. In this way a single larva may destroy or injure several shoots before reaching maturity, thus greatly increasing the damage.

Professor Comstock's observations on the habits of the larvæ in the young shoots are slightly at variance with the above. He says the larvæ puncture the shoots at the base, eating them off completely, the severed twigs remaining attached to the branch by the gummy substance which exudes from the wound. This particular form of injury we have not noted.

FIG. 2.—*Anarsia lineatella*: *a*, new shoot of peach withering from attacks of larvæ; *b*, larva enlarged; *c*, pupa enlarged (original).

When working in the succulent new growth the larvæ bores rather rapidly, sufficiently so at least to excavate a burrow two-thirds of its length in an hour. The length of time spent by the hibernated larvæ in coming to full growth in the green shoots is comparatively short, not exceeding ten to fifteen days.

In California and also in Washington the larvæ begin transforming to pupæ in the latter part of April, and the moths of the first brood emerge throughout May.

The adult larva tapers strongly toward either end, and attains a length of three-eighths to a half-inch, or slightly more when in motion. It is of a dull reddish-brown color, the reddish color predominating before maturity and the latter after maturity, and the head, and the cervical and anal shields are dark brown or almost black. The space between the segments is noticeably light-colored, and especially between the second and third thoracic segments. The hairs are long and spring singly from minute tubercles. Other details of structural features are shown in the illustration (fig. 2 *b*).

In confinement the larva on reaching full growth spins a scanty web,

in no sense a cocoon, in the leaves and rubbish about the trees, or on the trees in the dried and shriveled leaves of the injured shoots, or it attaches itself exposed on the twigs or bark. After thus securing itself the larva immediately pupates, becoming a brown, rather robust, chrysalis (fig. 2, *c*, *d*). In midsummer these transformations are very quickly accomplished. A larva, for example, which webbed up June 29, pupated July 1, and the adult emerged July 8.

Mr. Ehrhorn states that it is very difficult to find the pupæ in orchards as the larvæ hide in all sorts of places, as in crotches of the branches, between dried leaves, and about small peaches likely to drop off.

The chrysalis stage lasts from seven to ten days, and the moths of the first brood begin to appear early in May and continue to emerge throughout this month and into June in the latitude of Washington.

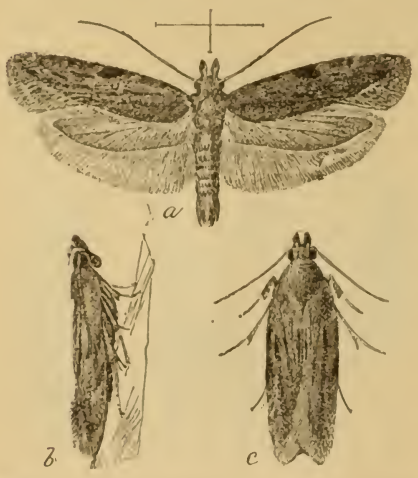

FIG. 3.—*Anarsia lineatella*: *a*, moth with spread wings; *b* and *c* same with wings closed illustrating position normally assumed—all much enlarged (original).

The adult moth is less than a quarter of an inch in length, expanding a little more than half an inch, and is of a beautiful dark-gray color, with darker spots on the forewings, as indicated in the illustration (fig. 3). It is a handsome insect and has a peculiar way of resting with its palpi bent back over its head and its antennæ laid closely down on the wings. The description of the insect by Clemens is reproduced:

A. ? pruniella.—Head and face pale gray; thorax dark gray. Labial palpi dark fuscous externally and pale gray at the end; terminal joint gray, dusted with dark fuscous. Antennæ grayish annulated with dark brown. Forewings gray, dusted with blackish brown, with a few blackish brown spots along the costa, the largest in the middle, and short blackish-brown streaks on the median nervure, subcostal, in the fold and one or two at the tip of the wing; cilia fuscous gray. Hind wings fuscous gray; cilia gray, tinted with yellowish. (Proc. Acad. Nat. Sc., Phila., 1860, p. 169.)

The egg-laying habits of this insect up to this time not having been discovered and for the fall brood even being merely a matter of conjecture, special effort was made to get the facts concerning this feature of the life history. A number of moths reared in the Insectary were confined about May 10 with peach twigs eight to ten inches in length, of this year's growth. The material was unfortunately not examined for too long a time, but on May 28 it was found that many eggs had been deposited on these peach twigs, an egg having been placed apparently just above the base of the petiole of nearly every leaf. When examined most of the eggs had hatched and the larvæ had entered the

twigs at or near the crotch formed by the leaf and twig, the point of entrance being indicated by a little mass of brown excrement.

The egg had evidently been placed in the protection formed by the two little spurs at the base of the petiole. Subsequently many other eggs were obtained from other moths, and they were, for the most part, similarly situated, namely, around the base of the leaves. In one instance nine eggs were deposited around the base of a single leaf, six of them close together under one of the bracts at the base of the petiole and three in the depression or scar left by the second bract, which had dropped.

The recently deposited eggs are white in color and iridescent, but becoming before hatching distinctly orange. They measure about four-tenths of a millimeter in length by two tenths of a millimeter in breadth, are somewhat ovoid, and are lightly attached lengthwise to the twig by a glue-like material. Under a high power they are seen to be coarsely and rather regularly reticulated, as shown in the illustration (fig. 4).

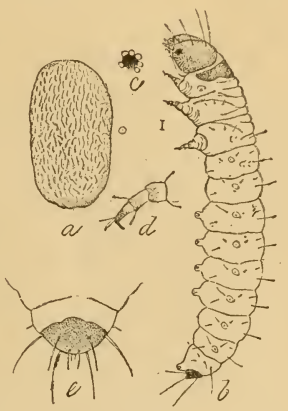

FIG. 4.—*Anarsia lineatella*: *a*, egg; *b*, young larva; *c*, eye; *d*, thoracic leg of same; *e*, anal segment from above—all greatly enlarged (original).

In confinement the moths live about ten days and most of the egg-laying is in the first half of this period. The habits above described are those of caged moths, but it is reasonable to suppose that in a state of nature the eggs are deposited in much the same way, and this is rendered almost certain by the great regularity noted in the manner of their deposition. In but one or two instances were the eggs placed in other situations—one being placed on the upper surface of a leaf close to the midrib and two together placed in a groove at the side of the base of the leaf.

From eggs deposited later than those first mentioned, viz, about June 3, larvæ appeared June 15, indicating a period of about twelve days between the laying of the egg and its hatching.

Most of the larvæ coming from the first lot of eggs had cast one skin when discovered. The smallest larvæ found measured about 1 millimeter in length and were of a very pale yellow color, with the head and cervical and anal plates black and the thoracic legs dusky. They had excavated channels somewhat longer than themselves and about twice as broad into the twigs, the entrance being marked by a small mass of excrement. By June 3 most of these larvæ had abandoned their original burrows and were constructing new ones in similar situations on fresh branches of the peach, with which they were from time to time supplied. This they continued to do, viz, to construct new burrows every few days, until they were full grown. On June 23, of the three remaining individuals of this lot of larvæ, one had already

pupated in a folded leaf and the other two were fully grown and about ready to transform, which they both did before the end of the month.

About the end of June Mr. Ehrhorn sent us some peaches said to be infested with the second brood of larvæ. Some of the peaches had been bored into a little way near the stem by what was evidently, from the size and nature of the burrows, nearly full-grown larvæ of the second brood. One of these was found, and also one pupa. On further examination, however, it was discovered that the larvæ of what is undoubtedly the third brood—the second of the summer broods—were present in numbers, not in the fruit, but in the short stems of the fruit which at this season are green and somewhat succulent. In these stems they had made their little chambers not unlike those in the twigs above described or those in the crotches in the fall, except that they were for feeding purposes and not lined with silk, as are the latter. Others were also found at the base of the leaf stalks just as we had been finding them in our breeding cages.

We were unable to carry our breeding-cage material farther than this point at Washington, and Mr. Ehrhorn was unable to furnish additional supplies, but he writes that he found the minute larvæ in the crotches of the trees as early as August 21. It would seem from this last and very important observation that some, at least, of the fourth brood of larvæ, if not all of them, go into winter quarters and at a period much earlier than would have been supposed.

These facts go a long way toward clearing up the life history of this insect, and indicate a much more uniform habit in the different broods than has hitherto been supposed.

The old idea that this insect is double-brooded, the first brood living in the twigs and the second brood affecting the ripening fruit, must be abandoned. At the time of the appearance of the first brood of moths during the month of May the fruit of the peach is of considerable size, especially by the end of the month, but is green, hard, and densely hairy, and is probably rarely if ever chosen by the parent moths as a nidus for her eggs. The normal location of the eggs and the point at which larval development begins is indicated by the foregoing notes, and there is no reason to doubt but that at all seasons of the year larvæ develop in the new growth, entering normally at the axils of the leaves or in the stems of the green fruit. In these situations the eggs are placed and the young larvæ construct their little oval chambers, which they abandon from time to time to make new ones, rarely doing enough damage in the later broods at any one point to be noticeable. As they attain larger size they travel more and often bore into fruit near the stem, where the greater exudation of gum and more serious character of the injury draw attention to them. In the case of the burrows in the twigs the more abundant new growth and more mature condition of the wood render the injury much less noticeable, nor are the results of the attacks so marked as in the injury to the new growth in April.

Our records for the first summer brood indicate a period of about six weeks as necessary for its complete development. The time necessary in the warmer months for the later broods is probably even less, and it is evident that there are certainly three broods of larvæ annually, if not four.

One of the important points remaining to be cleared up in regard to this insect is whether the larvæ found in the crotches of the branches in late summer and fall come from eggs placed in these situations or are migrants from some other parts of the plant. Mr. Ehrhorn's supposition that the eggs were placed by the moth where the larval chambers are afterwards found is borne out by the small size of the larvæ, which are not much larger than when newly hatched. The comparatively large size of the egg, and its striking appearance, and the lack of any attempt at concealment of it should enable one, where the insect is abundant, to clear up this uncertain feature without difficulty.

THE STRAWBERRY CROWN-MINER A DISTINCT INSECT.

The generally held belief hitherto that the lepidopterous crown-miner of the strawberry is the same insect as the twig-borer of the peach will have to be abandoned. If there were no other evidence on which to base this conclusion, the habits of the twig-borer, as now known, throughout the year are so peculiar and distinctive as to render very improbable the supposed strawberry-infesting habit, and this first led to my doubting the accuracy of the latter. This doubt became a certainty after a comparative study of the specimens of the larvæ in the Department collection from the strawberry and from the twigs of stone fruits, made in connection with an examination of the published descriptions of larvæ and their habits from both sources. The notes recently published by Cordley are in the main also confirmatory of this conclusion.

The original description of the larvæ of the strawberry crown-miner by Mr. Saunders is as follows:

> Length, 0.42 inch. Head rather small, flattened, bilobed, pale brownish-yellow, darker in color about the mouth, and with a dark brown dot on each side.
>
> The body above is semitransparent, of a reddish pink color, fading into dull yellow on the second and third segments; anterior portion of second segment smooth and horny looking, and similar in color to head. On each segment are a few shining reddish dots—yellowish on the anterior segments—or faintly elevated tubercles, from each of which arises a single, very fine, short yellowish hair, invisible without a magnifying power. These dots are arranged in imperfect rows, a single one across the third, fourth, and terminal segments, and a more or less perfect double row on the remaining segments.
>
> The under surface is of a dull whitish color, becoming faintly reddish on the hinder segments, with a few shining whitish dots; those on the fifth, sixth, eleventh, and twelfth segments being arranged in transverse rows, in continuation of those above. Feet and prolegs yellowish white, the former faintly tipped with dark brown. It spins a slight silken thread, by means of which it can suspend itself for a time at a short distance from its place of attachment.—(Ann. Rept. Ent. Soc. Ontario, 1872, p. 16.)

In the Department collection are specimens of the larvæ of the strawberry crown-miner from New York and Oregon which agree with the description above quoted by Saunders of the larvæ studied by him in Ontario and are totally different from all the true twig-borers which we have had from various parts of the country.

The larvæ of the twig-borer, *Anarsia lineatella*, as described by Glover, and as studied by Comstock (as shown by our examination of his notes and specimens) agree with each other and with the other larvæ received from various sources in the Department collection, and also with the material obtained from the twigs of various stone fruits from the Pacific Slope.

Clemens's brief description of the larvæ taken crawling on a plum tree corresponds in the main also with the twig-borer as we know it, but is too short and imperfect to be of much value, and fails to mention the distinctive anal shield unless it is included in the expression "terminal prolegs black." He says:

> The larva was taken June 16, full grown and about to transform on the limbs of the plum. Its head is black, body uniform reddish-brown with indistinct papulæ, each giving rise to a hair, and with pale brown patches on the sides of the third and fourth segments; shield and terminal prolegs, black. One specimen had secreted itself under a turned-up portion of the old bark of the trunk. The cocoon is exceedingly slight, and the tail of the pupa is attached to a little button of silk. The pupa is ovate, abdomen short and conical, smooth; color, dark reddish-brown. I do not know on what part of the tree the larva feeds.—(Proc. Acad. Nat. Sci., Phila., 1860, p. 170.)

The dark color of the body generally and the black head, thoracic shield, and anal prolegs (and probably anal shield) remove Clemens's larva absolutely from the strawberry crown-miner and ally it to the twig-borer, with which its location on plum also places it.

All the evidence bearing on this matter is in accord, except the statement by Mr. Cordley that the larvæ received in peach twigs in the spring of 1896 from various localities in Oregon agree with the larvæ found by him in strawberry plants later in the same year, both agreeing with Saunders's description. Curiously enough, however, the twig-boring larvæ which he got in numbers the following spring (1897) are of the normal type and entirely distinct from the former, which would certainly seem to throw doubt on the previous statement, and particularly in view of the facts we have already given.[1]

As a way out of the difficulty, Mr. Cordley suggests possible dimorphism, or that there are two distinct insects involved, and that the strawberry crown-miner may occasionally work in the twigs of the peach. That this last suggestion may be true is not impossible, but before acceptance needs substantiation by additional proof.

At any rate, the true larva of *A. lineatella*, viz, the twig-borer, has

[1] In his subsequent reproduction of his notes on this insect (note, p. 10) he states that none of the larvæ first mentioned were preserved, and that he relies on his recollection of the matter only.

not been taken in the crown of the strawberry, so far as the available records and material indicate. The strawberry crown-miner, on the other hand, may be more general in feeding habit, but in the matter of relationship to the former does not, in the larval state, show any close kinship, and more resembles a tortricid than a tineid larva.

The moths of the strawberry crown-miner, judging from the fact of their being generally classed with *lineatella*, must be very similar in appearance to the latter insect. Mr. Cordley says, however, that when alive their habits are not at all alike, although as dry, mounted objects they are very difficult to distinguish. The twig-borer moths are, however, slightly larger and darker colored. He says:

> Those reared from the strawberry crowns crawl down among the vines, even into crevices in the soil, apparently for the purpose of depositing eggs upon the crowns, and when disturbed run or flutter about with wings half spread. On the other hand, the moths of the twig borer invariably take an elevated position in the breeding cage, and with the fore part of the body slightly raised and the labial palpi held rigidly upright in front of the face they present a very characteristic and alert appearance. When disturbed they dart rapidly about, suddenly alighting again in the same characteristic attitude upon another portion of the cage.—(Bull. 45, Oregon Agric. Exp. Sta., June, 1897, p. 126.)

We have evidently, therefore, a strawberry insect entirely distinct from the old *Anarsia lineatella* of Europe and this country which infests stone fruits. The former seems undescribed, so far as the adult is concerned, although its habits are fairly well ascertained. It is highly desirable, therefore, that some of our specialists in microlepidoptera should give it a good description and name, if it proves not to have been hitherto characterized.

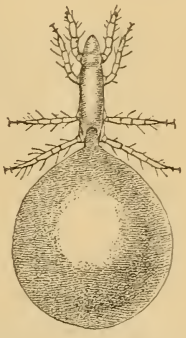

FIG. 5.—*Pediculoides ventricosus*—much enlarged (original).

NATURAL PARASITES.

That this insect is attacked by parasites during its hibernating period has already been alluded to, and in fact, of the material received from Mr. Ehrhorn, nearly all of the larvæ had been destroyed by a minute predaceous mite, *Pediculoides ventricosus* (fig. 5). In most cases nothing remained of the larvæ except the empty head.

Professor Comstock in his studies of the peach twig-borer reared a parasite from it which he did not name, but which was later described by Dr. L. O. Howard as *Copidosoma variegatum*.

A new parasite of *Anarsia* was obtained from the material in tree crotches submitted by Mr. Ehrhorn, which Mr. Ashmead has identified as his species, *Oxymorpha livida*. The specimens reared from the twig-borer are smaller than the type, but the species is a wide-spread one and quite variable in point of size.

Of these parasites in California the greatest benefit is derived from the mite, which, as we have already stated, frequently causes the death of from 75 to 95 per cent of the young larvæ.

REMEDIES AND PREVENTIVES.

The common method of procedure against this insect, and the one hitherto generally suggested, is to clip off and burn the withering infested tips in the spring as soon as the injury is noted. The foregoing life history emphasizes the fact that it is necessary to do this very promptly, for the larvæ remain in these situations a very short time, and early in May the larvæ will have abandoned their burrows in the young shoots to transform, often elsewhere, although sometimes pupating in the withered leaves. The presence of dying terminals does not always indicate that a larva is necessarily present, since in many instances it will have wandered to some other point. With large orchards this step would be a very tedious one and with trees of any size often impracticable.

The knowledge of the hibernating habits of this insect indicates a more effective method of control, namely, the one already recommended by Mr. Craw on the strength of Mr. Ehrhorn's observations. This is in spraying the trees during January or February with kerosene emulsion or resin wash, or some similar oily preparation, which will penetrate the burrows and destroy the young larvæ.

It is possible that something could be accomplished by an arsenical spray in the fall, but special care would have to be taken to get it where the eggs are apt to be placed. Many of the larvæ might thus be poisoned while eating through the bark preliminary to the construction of their hibernating burrows. To effect anything by this course the poison must be applied early—that is, before the eggs are deposited—and its feasibility will depend somewhat on the conditions of the trees and the danger of scalding foliage.

In the matter of spraying with poisons for this insect a timely suggestion is made by Mr. Cordley, viz., to spray the trees with paris green just when the leaf buds are unfolding, so that the first meal taken by the larvæ in the spring will be a poisonous one. In spraying the young tender foliage of the peach, plum, etc., a strength should be used not greater than one pound of the poison with an equal amount of lime in 200 gallons of water.

BIBLIOGRAPHY OF THE PRINCIPAL WRITINGS.

The following bibliography of this insect gives the principal writings but omits a number of unimportant references which merely repeat the common information relative to the species. Some of the articles cited, as will be duly indicated, relate in part at least to a distinct insect, viz, the strawberry crown-miner, which seems to be undescribed.

ZELLER, C. P.—Isis, 1839, p. 190.

Contains the original description of the moth.

CLEMENS, Dr. B.—Proc. Acad. Nat. Sci., Phila., 1860, p. 169.

Describes the insect as *Anarsia pruinella* from an adult reared from a larva taken crawling on a plum tree.

CLEMENS, Dr. B.—Tineina of North America, Stainton edition, 1872, p. 128. Ibid., p. 36, *in litt.* to Stainton, identified with *A. lineatella.*

CHAMBERS, V. T.—Canadian Entomologist, Vol. IV, 1872, p. 208.

Shows the identity of *prunella* with *lineatella.*

CHAMBERS, V. T.—Bul. U. S. Geolog. and Geog. Surv. Terr., IV, 1878, pp. 112, 129.

Gives food plants and references.

SAUNDERS, W.—Ann. Rep. Entom. Soc. Ontario, 1872, p. 15.

Describes injury to strawberry caused by what is supposed to be this insect under the designation the strawberry root and crown borer; larvæ stated to be so abundant in places in Ontario as to almost destroy the strawberry beds by eating into the crown of the plants and excavating channels and chambers; said to be double-brooded, the first brood wintering in a half-grown state in the crown of strawberry, while the second brood attacks the young runners soon after the fruiting season; also reported in Ontario to infest buds and twigs of peach.

GLOVER, T.—Entomological Record, Monthly Rept. U. S. Dept. Agriculture (July), 1872, pp. 304–5.

Figures moth and larva and burrow in peach twig; said to be very troublesome in peach orchards of Maryland and Virginia; its presence first noticed during the preceding season; twigs described as injured before leaving, in some cases all of the young twigs killed to a distance downward from 1 to 2½ inches, the larvæ entering near the terminal bud; suggests pruning and burning of injured shoots while the caterpillars are still within them.

GLOVER, T.—An. Rept. U. S. Dept. Agriculture, 1872 (1873), p. 112.

Repeats the information given above.

COMSTOCK, J. H.—Proc. West. N. Y. Hort. Soc., 1878, p. 13.

Description of insect and injury; gives figures.

COMSTOCK, J. H.—Rept. U. S. Dept. Agriculture, 1879, p. 255.

Gives in brief the habits of the insect; states that it attacks the newly expanded twigs, entering them at the base and eating them off completely, so that the branches wither and are held to the old wood merely by the gummy excretions; in some cases all of the twigs thus destroyed; describes the fact of the second generation developing in the ripening fruit, in which larvæ were found in Blackistone Island, Virginia, throughout the season, and also on the grounds of the Department of Agriculture; the larvæ leaving the peach, transform and attach to the outside of the fruit, making no cocoon; the twig-inhabiting generation said to mature in May and June, and the fruit-inhabiting brood in the latter part of July and throughout August.

LINTNER, J. A.—First An. Rept. N. Y. State Entom., 1882, p. 151.

Gives bibliography and quotations from previous writers, describing the insect and its habits, and reports it to occur in possibly eight localities in the State of New York; figures the moth; refers to the existence of a parasite, and details remedies.

FORBES, S. A.—Trans. Miss. Valley Hort. Soc., 1883, Vol. I.

In a comprehensive article, entitled "Insects affecting the strawberry," the habits, etc., of the supposed *Anarsia lineatella* as a crown-miner in strawberry plants are given.

FORBES, S. A.—12th Rept. St. Ent. Illinois, 1882 (1883), p. 76.

Reports the occurrence in Illinois of the strawberry crown-miner, which is supposed to be *A. lineatella;* quotes previous literature both as twig-borer in peach and crown-miner in strawberry; suggests remedies; figures larvæ from strawberry.

RILEY, C. V.—Prairie Farmer, Nov. 24, 1883.

Refers to the occurrence of the larvæ in strawberry plants in Illinois.

RILEY, C. V., and HOWARD, L. O.—Insect Life, Vol. I, 1888, p. 196.

Gives a general account of the peach-twig moth in Delaware and Maryland, referring to a report of excessive damage in Kent and Sussex counties, Del.; refers to the literature and describes the parasite (*Copidosoma variegatum* Howard), referred to but not named in Professor Comstock's report.

COQUILLETT, D. W.—Insect Life, Vol. IV, 1892, p. 206.

Describes the work of larvæ, supposed to be of this insect, in California, in prune, peach, apricot, and other trees.

RILEY, C. V., and HOWARD, L. O.—Insect Life, Vol. VI, 1894, p. 373.

Report of Mr. Chatfield Knight, of Vancouver, that this insect is doing considerable damage in the State of Washington—as many as one hundred larvæ being found upon a single 3-year old prune tree.

CRAW, A.—Bul. 67, Calif. State Board of Hort., 1893 (1894), p. 9.

Reports the results of investigations made by Mr. E. M. Ehrhorn in Santa Clara County, Cal., showing that the insect winters in the early larval stage in the crotches of the branches of the trees attacked; eggs of the last brood supposed to be placed in these situations in the fall, and the larvæ to grow very slowly at the point indicated until the new leaf growth appears, when they leave their burrows in the bark and enter the new shoots, the later brood working in the fruit near the stem.

CORDLEY, A. B.—Bul. 45, Oregon Agr. Exper. Station, June, 1897, p. 123, Pl. VII.

Reports extensive injury in Oregon in 1896–97 to prune and peach twigs in early summer, and of a similar larva in strawberry beds in October, the larvæ wintering in the crowns of the plants. Gives various notes on larvæ and habits of living moths, which seem to indicate that the strawberry insect is a distinct species. Describes the injury and suggests remedies.

CORDLEY, A. B.—Bul. 9, Div. Entomology, U. S. Dept. Agriculture, pp. 71–75, Oct., 1897.

Reprodnces the above in different form, adding some later observations.

THE FIG-EATER, OR GREEN JUNE BEETLE.

(*Allorhina nitida* Linn.)

By L. O. HOWARD.

Few insects are more commonly noticed through the summer months in the more southern United States than the beautiful green and brown species known as the fig-eater, or June beetle. It is nearly as beautiful in its way as some of the metallic Brazilian beetles which have been used in jewelry, and is a favorite plaything with children, who tie strings to the body and let the beetles fly with a humming noise, which is known in the Southern child's vocabulary as "juning" (verb "to june"). Notwithstanding its beautiful appearance, this beetle is a more or less serious enemy to agriculture and horticulture in parts of the South, and has been suspected to be a much more serious enemy than it really is. It is a native of the southern and central portions of the United States, and has not been found, so far as we are aware, north of the dividing line between the upper austral and transition life zones.

In its adult condition the beetle feeds upon ripe figs, peaches, pears, plums and small fruits such as raspberries and blackberries. It feeds

also, occasionally, on ears of corn before they harden, and has also been recorded as feeding upon the sap exuding from the wounds in the branches of trees. That it does not confine itself to injured twigs is shown by the item published in Insect Life (Vol. IV, p. 75), in which it is recorded as burrowing into the tender branches of oak trees. In this case, which was at Springfield, Mo., the insects were very numerous, and caused the destruction of many young branches of black oak, scrub oak, and post oak. A beneficial habit was noticed by Mr. W. W. Meech, the well-known quince grower of Vineland, N. J., and is recorded in Volume I (pp. 88–89), Insect Life. Mr. Meech found the adult beetles eating the fungus, *Rastelia aurantiaca*, upon his quince trees. They even alighted upon the fungus in his basket when he was gathering it and ate it greedily.

The closely allied species, *Allorhina mutabilis*, which occurs in the extreme southwestern portions of the United States, has similar habits and is even more noted as damaging fruit. This insect appears after the first summer rains in Arizona and New Mexico and immediately seeks the peach orchards, where it selects the choicest fruits and ruins them. In case there are no ripening peaches, it feeds upon grapes and even upon growing cornstalks, disappearing during the latter part of August. A correspondent, Mr. John B. Miano, of Tombstone, Ariz., writing to the Department in September, 1889, said that frequently these beetles could be noticed by thousands and millions in the trees, devouring the apricots, peaches, figs, prunes, plums, pears, apples, and grapes.

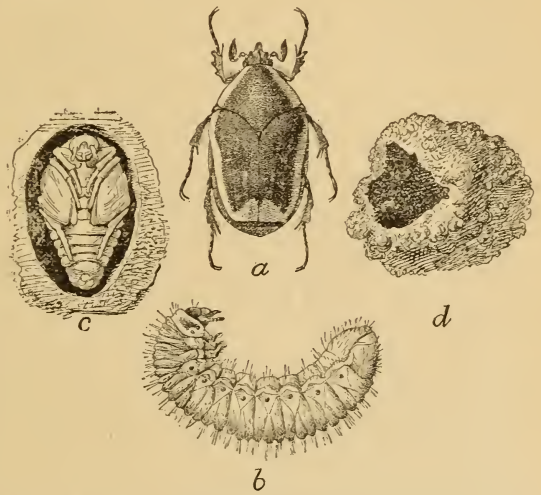

FIG. 6.—*Allorhina nitida: a*, adult; *b*, larva; *c*, pupa in a cut-open cell; *d*, pupa cell—natural size (original.

In its larval condition *Allorhina nitida* is a "white grub," much resembling the common white grubs of the northern States, which are the larvæ of the species of Lachnosterna, a genus of scarabæid beetles belonging to quite a different tribe from the Allorhina. These white grubs of the Allorhina live at or below the surface of the ground, and frequently occur in countless numbers in grass lawns, in strawberry beds, in celery beds, and in fact wherever the soil is very rich and the vegetation is vigorous. The actual amount of damage done by these larvæ is problematical, and, in fact, it is even problematical whether they normally do damage at all. In a note published in the Canadian Entomologist for October, 1879, the writer mentioned the fact of the

extreme abundance of these larvæ in the grass lawns on the west front of the Capitol at Washington, but, at the same time, showed that the lawn was so green and healthy in appearance as to cause admiring comment. This, however, was after a rainy summer. In June, 1888, these larvæ were apparently responsible for very considerable damage to the lawns on the east front of the Capitol. The grass turned brown and the larvæ were found to be present in extraordinary numbers. This, however, was during a dry month, and Lachnosterna larvæ were also present.

In 1893 the larvæ were found to be swarming in choice celery beds near Washington. The only vegetation in the vicinity of the beds was the celery itself and there had been no grass or low vegetation upon the field during the previous summer. Observations were begun in October. Very careful examination failed to show any damage to the roots of the celery, but the crop was slightly damaged by the carriage of dirt into the heart by the larvæ and by their acid excrement causing rot. During the daytime they remained constantly under the surface of the ground, and there was abundant evidence that they come out to the surface at night and even crawl up the plants for an inch or so. In this case, as in all the cases which we have investigated in which these larvæ were more than usually abundant, the beds were heavily mulched with large masses of rotting straw mixed with a considerable amount of stable manure, and the extraordinary number of the larvæ seems with little doubt to be accounted for by the fact that such conditions attract the beetles and they lay their eggs under such circumstances. The writer has repeatedly noticed them ovipositing in the earth of the heavily manured flower beds on the grounds of the United States Department of Agriculture at Washington, while apparently no attempt was made to oviposit in the adjacent lawns.

Occasionally a great abundance of larvæ in strawberry beds may be accounted for in the same way. It is a matter of regret that no direct observations have been made upon the feeding of this larva. Such observations, however, are very difficult to make. Attempts have been made with the aid of the Comstock root cages, but without result. Larvæ have been watched repeatedly for more or less extended periods, but have never been observed to feed. The direct evidence on this point, therefore, is very meager, and their normal feeding habits can only be surmised, although this surmise may be made with a considerable degree of positiveness.

Every writer who has published an account of the habits of this insect has assumed that the larva feeds upon the living roots of plants, but the only exact observation on record is that mentioned by Riley in Bulletin No. 23 of the Maryland Agricultural Experiment Station, in which he says that in 1868 in his breeding cages the larvæ fed greedily upon roots of wheat which he grew for them. In addition to the contrary evidence already given, Prof. C. H. Tyler Townsend recorded in Insect Life (Vol. IV, p. 25,) the finding of Allorhina larvæ in a bare spot

of ground near Mesilla, New Mexico, on which not a particle of vegetation had grown for three years. Sixteen grubs were secured in a square foot or two of ground. These larvæ were probably *A. mutabilis* and not *A. nitida*. Further, the feeding of the larvæ upon the bran-arsenic mash and the efficacy of this remedy against them, as described later under the section on remedies, is additional evidence against the normal feeding on living vegetation, although it must be confessed that certain plant-feeding insects will also feed on this mash.

In the celery beds above referred to the grubs were found to be fully as numerous in one part of the field as another, while the direction of the burrows had no reference to the presence or absence of living vegetation. The numbers of the insects were so extraordinary that had they been vegetable feeders no living vegetation could have existed on the field; whereas, in point of fact, no damage to the vegetation whatever, such as would be produced by feeding upon the roots, could be observed. An examination of the contents of the alimentary canal also at once directly negatives the vegetable feeding habit. The food is obviously decaying vegetation—soil humus. In view of the well-known habits of the group of Scarabæidæ, to which Allorhina belongs—namely, the Cetonians, all of the species of which, whose habits are known, being feeders upon decaying vegetation only, it seems strange that the root-feeding hypothesis should ever have been adopted. Probably the basis of such an hypothesis was the great abundance of the larvæ in the soil and their resemblance to Lachnosterna larvæ.

That these larvæ may occasionally cut off a plant root, or that they may, as stated by Riley, when in confinement occasionally devour the roots of plants, is possible. They have reasonably strong jaws, and, as is well known, the normal habits of an insect are greatly altered in confinement. It is well known in Europe that the larvæ of the cockchafer (*Melolontha vulgaris*), which normally feed upon the roots of vegetation, become carnivorous in confinement—the larger larvæ feeding upon the smaller ones. Similar observations have been repeatedly made with the Allorhina in the course of the rearing-cage experiments at the Department of Agriculture, and by Mr. R. S. Lull, when engaged in work for this office at the Maryland Agricultural Experiment Station. Mr. Lull's experiments show that under these conditions they not only feed upon one another, but also upon earthworms, which were placed in the jar for the purpose of this experiment. Professor Townsend also has recorded in the article above mentioned the feeding of the larvæ of *Allorhina mutabilis* upon an undetermined elongate white larva when left over night together in a tin can.

Taking all these considerations together, it is probably safe to say that the normal food of the Allorhina larva is the vegetable mold of rich soils, and that in its larval stage it is not a crop pest.

The length of life of the larva is unfortunately a matter of some doubt. It has been found impossible, in spite of repeated attempts, to

carry the larva through the entire life. In late autumn the majority of the larvæ which may be found appear to be of two distinct sizes, yet at this time, also, a certain number of larvæ of almost every size will be found. The prevalence of the two sizes mentioned would seem to indicate that the species occupies two years in its larval development, yet Dr. Riley, in Bul. 23, Maryland Agricultural Experiment Station, was inclined to attribute the difference in size to difference of period of egg laying and hatching and to believe that the insect may go through all these transformations in a single year. He believed that the eggs are laid during any of the summer months, and often during September. It is true that at Washington the beetles are seen flying from June to the middle of September, and sometimes even later.

The full-grown larva, which has been carefully described by Dr. Riley on page 78 of the bulletin above mentioned, may be distinguished from the larva of Lachnosterna by the possession of stiff ambulatory bristles on its back and by the darker, more horny, and more closely punctured head. The whole body, in point of fact, is harder—it is not so soft and delicate as that of the Lachnosterna larva. Aside from these structural peculiarities, the larva, when placed upon a smooth surface, crawls upon its back with great ease and rapidity. The Lachnosterna larva, when so placed, struggles awkwardly about and rests upon its side. The Allorhina larva, however, immediately turns upon its back, straightens its body out, and by the alternate contraction and expansion of the body segments wriggles rapidly away in a straight line. Frequently, on the Capitol grounds, the larvæ are driven to the surface by a heavy fall of rain, struggle out of the lawn upon the smooth concrete walks, and are noticed scooting about on their backs in such numbers that the sweepers frequently collect them almost by the bushel in a morning. This habit was first recorded by the writer in the article in the Canadian Entomologist above cited.

In the spring, the full-grown larva forms for itself a tough, hard cell of earth, in which it changes to pupa, remaining in the pupal stage about a month, the adults issuing in May and June, although in 1881 a single beetle was reared in the fall—October 19. The following year a single specimen issued as early as March 12. The cell of the pupa in this latter case (the one figured) was oval in shape and was composed of the sand in which the larvæ were put for breeding purposes. It was thin shelled and quite strongly cemented with some mucilaginous larval secretion. The full-grown larva, the adult beetle, the pupa cell, and the pupa itself are well shown in the accompanying figure.

REMEDIES.

Where the beetles are abundant and are damaging ripe fruit it is a comparatively easy matter to attract them in numbers to a little heap of spoiled fruit upon which has been sprinkled Paris green. In this way many may be killed. An experiment of this kind was first tried at the

writer's suggestion in 1888 by Dr. F. L. Kilbourne at the Experiment Station of the Bureau of Animal Industry, Bennings Road, District of Columbia. It is quite likely, however, that the destruction of beetles in this way is generally accomplished only after the eggs have been laid, although upon this point no definite observations have been made. Against the larvæ in the ground, successful experiments have been made with the use of diluted kerosene emulsion on a large scale. In 1888 such an experiment was made by Mr. W. B. Alwood, at that time an assistant in this office, under instructions from the writer, in the Capitol grounds at Washington. The standard emulsion, diluted 15 times, was applied by the barrelful, and subsequently washed down by copious applications of water. The experiment was perfectly successful, and a full account of it will be found in Insect Life (Vol. I, pp. 48–50).

Further experiments along this same line were made in 1893 in the 1-acre celery field of Col. Wright Rives at Rives Station, Md. The experiments were made by Mr. Lull, but were only measurably successful. The application of a standard kerosene emulsion diluted in 15 parts of water did not injure the celery and killed the larvæ which were at or near the surface of the ground, but apparently did not injure in the least those which were 2 inches or more beneath the surface. Colonel Rives was advised by the writer to take advantage of the habit which these larvæ seem to have of coming to the surface during a heavy rain storm by flooding his field (he had abundant water piped to the spot), and then when he had brought them to the surface in this way to treat them with the diluted kerosene emulsion. There can be no doubt of the success of this method had it been tried, but for some reason it was not tried. Experimentally and on a small scale it was tried by Mr. Lull with success. Dr. J. B. Smith (16th An. Rep. N. J. State Agr. Exp. Sta., 1895, p. 511) states that a liberal top dressing of kainit and lime slacked together, in the proportion of 100 bushels of lime to 1 ton of kainit, "seems to have answered very well in some parts of New Jersey. * * * It has been found satisfactory wherever used, and is certainly worthy of a trial wherever these insects are troublesome."

In 1896 Colonel Rives, finding the larvæ more abundant than ever in his celery beds, tried of his own idea a modification of the bran-arsenic mash, a remedy which has been successful against grasshoppers in California and elsewhere and against cutworms in different parts of the country. Had Colonel Rives consulted the writer before trying this remedy, it is safe to say that he would have been told that it would be absolutely inefficacious. Nevertheless, according to his statement, it was a perfect success. The following statement is in his own words:

"On a brick floor I put about 20 bushels of bran and spread it out thin. I took a watering pot and filled it full of water and put a quantity of common molasses in it, so as to color it very strongly and make the water very sweet. I then took this and sprinkled the bran very

thoroughly on top. Then I turned the bran over and sprinkled it thoroughly again, and continued to do that, sprinkling and turning until the bran was moist throughout. I then took Paris green and sprinkled it all over the bran. I turned that over and sprinkled another layer of Paris green, and kept turning and sprinkling until the Paris green was thoroughly incorporated with the bran. I then took it and spread it lightly on the ground where the white grub was, and in the course of two or three days I might say I completely eradicated it."

NOTES ON CUCUMBER BEETLES.

By F. H. Chittenden.

During the year 1897 very general complaint was received at this office of an insect that destroyed the vines of cucurbits near the roots, and in most instances *Diabrotica vittata*, the striped cucumber beetle, was responsible for a major portion of the injury. This species was observed in its different stages, and some notes were made on its habits

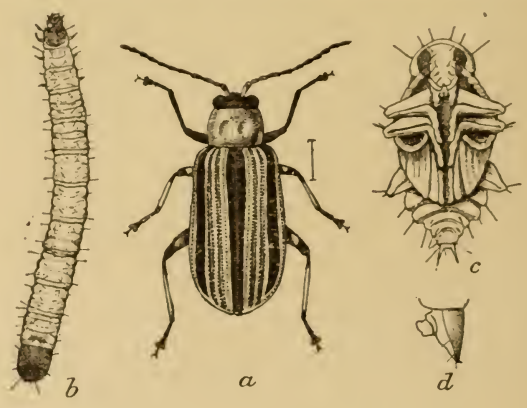

Fig. 7.—*Diabrotica vittata*: *a*, beetle; *b*, larva; *c*, pupa; *d*, anal segment, from side; all enlarged to same scale except *d*, which is more enlarged (original).

and life economy. *Diabrotica 12-punctata*, the so-called twelve-spotted cucumber beetle, or Southern corn root-worm, also came under observation from its association with the above-mentioned species.

All of the observations which will be recorded were made in the District of Columbia or in Maryland near the District border line.

THE STRIPED CUCUMBER BEETLE.

(*Diabrotica vittata* Fab.)

Recent injury; food plants.—Injury to cucumber, squash, and cantelope by this species is so well known and has been so general in Maryland and Virginia in the vicinity of the District of Columbia in recent years that special mention of infested localities is superfluous. Indeed, this cucumber beetle is rarely absent from the farm and garden over an area which embraces nearly our whole country, and is by far more

common and more destructive than any other cucurbit pest with which we have to deal.

This species first came to notice in the first week of July, where cucumber plants were seen to be dying just before the ripening of the fruit. Larvæ were taken at the roots of infested plants and reared to the adult. September 20 beetles were so numerous on the fruit of cucumber as to spoil it for market. They were also found in abundance cutting holes into canteloupes, and during the last week of that month and the first of October were still more plentiful, eating numerous holes in the foliage of late watermelons and attacking the fruit as well, eating off the rind in large patches. October 6 leaves and nearly ripe pods of beans, here and there in a patch, were found to be severely attacked by the beetles. They would congregate in numbers upon a single leaf or pod, or upon a bunch of these, with the result that the leaves attacked would die and the bean pods would be rendered so unsightly as to be useless for the market.

A considerable proportion of the beetles found at this last date had evidently developed within a week or two, as many were quite soft and delicate and not fully colored.

Among wild plants the writer has for years noticed the partiality of the beetles for the flowers of golden-rod and asters. The present autumn beetles were observed to devour the colored portions, stamens, pistils, and ray flowers of these plants, and it is probable that they attack several other composites which bloom at this time.

Dr. Lintner refers to instances of serious damage by *D. vittata*, reported by the Pacific Rural Press of June 11, 1887, to pear, quince, and almonds in Byron, Cal., but it seems more than probable that the insect concerned in this injury is *D. trivittata* Mann., which does great damage to the buds of fruit trees in California, where it replaces *D. vittata*.

Injury by this species, as is well known, is largely due to the work of the beetles upon young plants, which they often damage beyond recovery soon after, and even before, they appear above ground. Injury by the larvæ, the writer suspects, is nearly, if not quite, as serious in many cases, especially where other insects—such as the vine-boring Melittia larvæ in the stems, or the squash bug or plant-louse on the foliage—are also at work. The subterranean habit of the larvæ makes it certain that they are more often than not at the roots of cucurbits without the knowledge of the grower, the outward manifestation of their presence being the wilting of the leaves and the failure of the plants to develop perfect fruit.

Judging by recent observations (F. M. Webster, Ent. News, Vol. VII, p. 139), even the expedient of starting cucurbits in greenhouses is not a perfect remedy for this insect, as it has been reported, both as larva and beetle, as destroying cucumbers in greenhouses in midwinter near Cincinnati, Ohio.

As no very good illustration of the larva and pupa of this species has been published, occasion is taken to present the accompanying cut of the insect in its different stages, together with brief descriptions of the larva and pupa to facilitate their recognition. A few short notes are also added on the life history of the species.

Description, life history, and habits.—To the late Dr. Hy. Shimer and to Dr. Asa Fitch we are indebted for our first accounts of the earlier stages and life habits of this insect. These accounts were published in the same year, 1865, but that of Fitch, which appeared in his Tenth New York Report (pp. 1–8), was by far the more complete.

The egg does not appear to have been observed, but from analogy we may be certain that it resembles that of other Diabroticas.

The larva shown at *b*, fig. 7, is nearly cylindrical, narrowed anteriorly, somewhat flattened ventrally, and very elongate, its length when mature about ten times its diameter. Compared with *D. 12-punctata* the surface is much less strongly wrinkled. The general color is milk white, the head and anal plate dark brown and corneous, the thoracic plate lighter brown and somewhat corneous; the tubercles on the dorsal surface of the body are more or less distinctly marked with light yellowish brown; the six thoracic legs are infuscated, and the exterior margin of the coxæ are strongly marked with black. The head and thoracic plate and legs are best described by the accompanying figures (fig. 8, *a* and *b*). The anal segment with its retractile proleg is shown in profile at *d*, fig. 7. It terminates in two minute, acutely pointed, upturned teeth. The length of the full-grown larva is about three-tenths of an inch (7–8^{mm}), the width three-hundredths of an inch (0.7–0.8^{mm}).

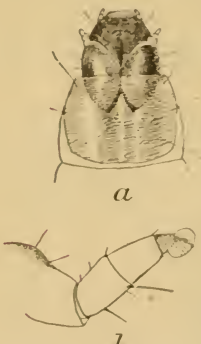

FIG. 8.—Larva of *Diabrotica vittata*: *a*, head; *b*, leg—greatly enlarged (original).

The pupa, shown at *c* (fig. 7), is of nearly the same color as the larva, its surface is sparsely beset with long spine-like hairs, those on the dorsal surface arising from small, but prominent piliferous warts. It is not impossible that we have in the arrangement of these hairs good specific characters, but no suitable material in other species is at hand for comparison. The apical hooks of the abdomen are slightly more slender and elongate than these appendages in *D. 12-punctata*.

The larval period is passed in the earth, at the base of the stalks, and larvæ are often found within the stems above ground. This period, although probably never observed, has been stated to last for about a month, and there is an active stage of this duration in which the larvæ working in numbers have ample time for injuring the vines. When full grown, just before transformation, the larva becomes much contracted, having the appearance of being much stouter, as it is then only about six or seven times as long as wide. Larvæ observed in July, 1897,

remained for three days in this contracted and curved position, and this is probably about the usual warm weather quiescent period before assuming the pupal condition.

Shimer states that the insect "remains in the pupa state about two weeks." This period will, of course, vary with climate and season. Experiment with a number of individuals early in August showed this period to be seven days in moderately cool weather (75° to 85° F.). The pupa during normal midsummer weather remains entirely white until the fourth day, but on the fourth day before transforming to beetle the eyes take on a light-brownish hue; on the third day this becomes dark brown, and on the second the eyes turn nearly black. On this second day also the tips of the mandibles acquire a reddish hue. Even just before transformation to beetle there are comparatively few changes, and the beetle itself when first transformed is mostly white, the thorax showing yellowish, and only the eyes, antennæ, mouth-parts, and knees and tarsi of the legs, showing infuscated.

Transformation to pupa takes place in a fairly well-defined pupa case in the earth, in which the insect has been living as larva.

One beetle was observed just transformed from pupa at 8 in the morning, but early on the following morning, it was found, although not fully colored, to be quite active.

The dates of earliest appearance and disappearance of an insect are often difficult of ascertainment. The present species appears in the vicinity of Washington some time in April, and was last seen the second week of October. In ordinary weather the beetles probably remain in the field considerably later, but it rained almost continuously for the next three weeks after this last observation and no beetles could be found November 6.

The beetles of this species have a habit of hiding under clods of earth and other places of concealment. Toward the end of August beetles were seen to congregate in numbers under the stems, prostrate portions of the plants and withered leaves of cucurbits, often as many as fifty or sixty individuals having been counted about a single plant, and later they massed themselves upon such belated melons and other cucurbit fruit as could be found, as previously narrated.

The entire life cycle of this insect has evidently never been ascertained. Considering its long season, and the fact that newly transformed beetles have been observed from the second week of July till the first week of October, it is safe to assume the existence of at least three, and perhaps four, generations annually for the latitude of the District.

A dipterous parasite of this species has been very abundant the present season. It is found only in the adult beetles and has been reared from July to September in this latitude. This parasite, now referred to *Celatoria diabroticæ*, was first observed by Shimer in 1870 preying upon *Diabrotica vittata* Fab., and an account of it was given

in Volume V of the American Naturalist (p. 219), where it is described under the name *Tachina* (*Melanosphora*) *diabroticæ*. *Celatoria crawii* Coq., described and figured from specimens reared in California from *Diabrotica soror* (Insect Life, Vol. II, pp. 233–236) is a synonym. This parasite has also been reared from *D. 12-punctata*.

THE TWELVE-SPOTTED CUCUMBER BEETLE OR SOUTHERN CORN ROOT-WORM.

(*Diabrotica 12-punctata* Ol.)

Incidental to the occurrence of this species with the preceding a few observations on the eggs and egg period and on the habits of the insect were made and will be mentioned.

May 8, two females were noticed unusually distended with eggs, and an effort was consequently made to ascertain the complement that might be laid. The first individual was confined in a vial that evening, and the following morning 135 eggs were found, mostly in large masses and evidently laid in strings. The beetles were transferred to another vial, and by May 13 had deposited 16 more eggs in one mass. The second was found to have laid 105 eggs May 13, mostly in small masses of from two to a dozen or more, and a few days later 97 more were counted, a total of 202.

Eggs hatched in 6 to 7 days in cool weather in the first two weeks of May.

It may be remembered that Mr. Pergande has been placed on record (Insect Life, Vol. IV, p. 107) as authority for the observation that the beetle feeds upon the leaves of horse nettle (*Solanum carolinense*). Can it be possible that the larva also feeds upon solanaceous plants? I hardly believe so, and yet on August 18 of the present year I found at Glen Echo, Md., at the roots of a plant of Jamestown weed (*Datura stramonium*) a pupa which, to my surprise, developed into this species. The weed grew in a field of corn, and it would seem more probable that this was the food plant of this larva which had strayed for pupation.

On the 25th of August Mr. F. C. Pratt found in the suburbs of Washington a larva of this species in the soil about the roots of the pigweed, *Amarantus retroflexus*. No corn grew in the vicinity, and if this larva had not fed at the roots of the Amarantus it had probably come from some wild grass.

The larvæ or pupæ of this beetle have been taken by different observers about the roots of various other plants, among which are recorded wheat, Rudbeckia, and the sedges of the genera Cyperus and Scirpus. The sedges, at least, appear to be natural larval food plants, but further investigation will doubtless prove that the species breeds on various plants in addition to the Cyperaceæ and Gramineæ. It has not been found upon cucumber or other cucurbits except in the adult condition, and if it breeds upon these plants it must be exceptional; hence the name of twelve-spotted cucumber beetle should give way to the more appropriate one of southern corn root-worm. The species is

a Northern as well as Southern one, but it appears to be more injurious to corn in the South. The latter name serves to distinguish it from its congener, *D. longicornis*, the corn root-worm of the West and North.

The beetles have an especial fondness for beans and soy beans, and were observed the past year feeding on the upper surface of the leaves early in September. They make many small, irregular holes in a leaf, not at all like those of the bean leaf-beetle, which are large and rather regularly rounded. The beetles were observed feeding upon bean pods in the same manner as *D. vittata*, also on the petals and other portions of the flowers of cultivated Bidens and chrysanthemums on the Department grounds. They were noticeably much more abundant on a species of Bidens with orange ray flowers than upon another which had white ray flowers.

A young wheel-bug (*Prionidus cristatus* Linn.), about one-fourth grown, was observed June 28 with a beetle of this species impaled upon its proboscis. This bug evinces no partiality for beetles, but was noticed in the last week of October feeding upon the clover leaf weevil, *Phytonomus punctatus*.

I have been much interested in the perusal of Mr. F. M. Webster's article on the genus Diabrotica published in the Journal of the New York Entomological Society for December, 1895; but when the subject of the probable inedibility of Diabrotica by birds was raised, without any cause being assigned for this apparent protection beyond the supposed "warning" coloration of these beetles, I took the trouble to inquire into the matter to this limited extent. The beetles have, to me, a perceptible odor, similar to that of ladybirds, but so faint as to hardly seem worth considering as a means of defense. In response to inquiry of my neighbors, Messrs. Beal and Judd, of the Division of Biological Survey of this Department, I am informed that from examination of many stomachs it has been ascertained that many birds feed, and to a considerable extent, on both *Diabrotica 12-punctata* and *vittata*, preferably upon the former. This preference is due, evidently, to the larger size of this beetle, its more conspicuous coloration, its greater variety of food plants, and its habit of feeding during the day in more exposed situations.

From the past year's observations of *D. 12-punctata* it is obvious that the final disappearance of the beetle is limited only by the supply of natural food remaining for it. All through the prolonged rainy spell which lasted from the latter days of October until the middle of November these beetles were always to be found on the Department grounds, and in numbers, as often as the rain ceased. November 16 the beetles were still present in abundance upon the flowers of Bidens, although many blossoms had wilted and died. On the following day the weather turned much colder, the plants were mowed down, and no more beetles were to be seen. Obviously this is one of our latest beetles.

THE SUGAR-CANE BORERS OF JAVA.[1]

By Dr. L. Zehntner.

DIATRÆA STRIATALIS, SNELLEN.

The female of *Diatræa striatalis* lays about 75 eggs, always ten to twenty together and arranged in two rows (in the form of a zigzag), so that the eggs partly cover each other. The eggs are strongly flattened, have an elliptical form, and, as a rule, are found on the upper side of the leaves. Freshly laid they are greenish white or gray; afterwards they become orange or red. Length of an egg 1.5 to 1.8^{mm}, breadth 0.85 to 1.1^{mm}.

The young caterpillars are 2 to 2.25^{mm} long. They go between the young leaves, which are not yet unfolded. There they eat off the tissue of the leaves in spots, so that the epidermis of one side only remains. The presence of the caterpillars is indicated by their excrement as well

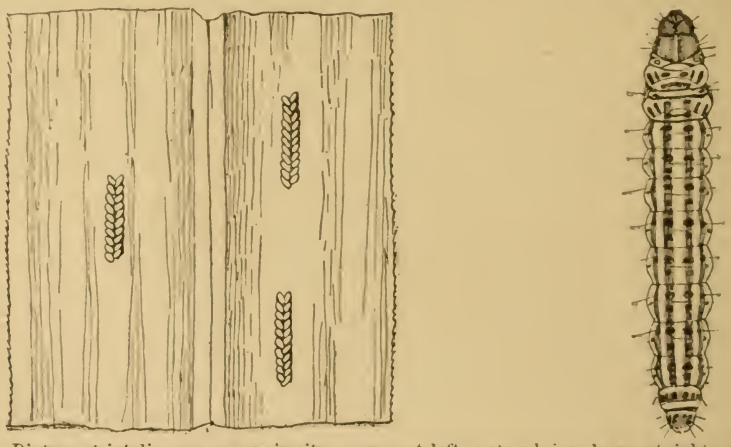

Fig. 9.—*Diatræa striatalis:* egg masses *in situ* on cane, at left—naturnl size; larva, at right—enlarged (after Zehntner).

as by the damaged leaves. After having changed their skins four times, the larvæ penetrate the stalk at different places, and commence to tunnel in an irregular manner. One often finds as many as ten larvæ in one stalk. During the burrowing in the stalk the larva changes the skin once more and thereafter transforms to the pupa, which lies as a rule near the surface of the stalk or between the stalk and the sheaths of old leaves.

The whole development is accomplished within the following periods: Development of the egg, 8 days; development of the larva, 37 to 40

[1] This article is a brief résumé of the results of some of the important and interesting studies which Dr. Zehntner has been making at the experiment station at Pasoeroean, Java, during the past few years. The results of his work are published in the numbers of the "Mededeelingen van het Proefstation 'Oost Java,'" from which publication the accompanying illustrations have been copied. The English abstract he prepared at our request.—L. O. H.

days; development of the pupa, 12 days; total, 57 to 60 days, or two months.

A few days after having left the pupa, the imago is ready for oviposition.

Often the caterpillars, which have just left the eggs, let themselves down by means of a long thread, in order to reach other leaves. During the suspension they are easily carried off by the wind and thus become widely spread.

Fortunately, very often the eggs are infested by two parasites, viz, *Ceraphron beneficiens* Zehnt., and *Chætosticha nana* Zehnt. The infested eggs turn to black or dark brown. Besides, the eggs are destroyed by the larvæ of a species of Chrysopa, which sucks them out.

SCIRPOPHAGA INTACTA, SNELL.

The female of *Scirpophaga intacta* lays her eggs in little clusters, and as a rule on the underside of the leaves. These egg-clusters are from 6 to 10^{mm} long, composed of 15 to 30 eggs, and are covered with abundant cinnamon colored hairs, so that the eggs themselves cannot be seen. The total number of eggs produced by one female is 60 to 70.

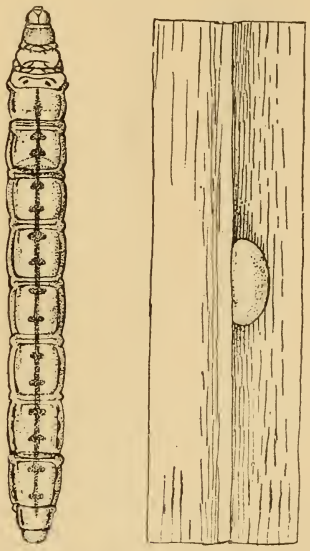

FIG. 10.—*Scirpophaga intacta:* full-grown larva at left—enlarged; leaf-blade with egg-mass at right—natural size (after Zehntner).

The freshly hatched caterpillars are dark brown in color and are about 2.5^{mm} long. They penetrate the shoots from above (say a single larva in each shoot), following in the beginning the midrib of the young unfolded leaves. Farther beneath they eat completely out the heart of the shoot. Finally, they attack the stalk, making a straight descending gallery or tunnel, which varies in length according to the individuals. When the larva is nearly full grown the gallery is bored horizontally outward by means of a gentle curve. Then the dust is removed from the lower part of the gallery (i. e., pushed upward), and the gallery is closed before and behind the larva with three or four transverse silken membranes spun by the larva. Thereupon this latter transforms to pupa.

The whole development is accomplished within the following periods: Egg state, 8 to 9 days; larval state, 32 to 35 days; pupal state, female, 8 to 10 days; male, 10 to 12 days; total, female, 48 to 54 days; male, 50 to 56 days.

In penetrating the stock the larva destroys always the growing veg-

etation point.[1] As a result the stalk grows no further, the youngest internodes remain short, and, in consequence, their leaves stand close together, forming a sort of fan. Moreover, four to six eyes of the stalk grow out. Often these young lateral shoots all die, as well as the old stalk.

The eggs are very often infested by *Ceraphron beneficiens* Zehnt.

CHILO INFUSCATELLUS, SNELL.

As a rule this borer lays its eggs in clusters on the under surface and near the base of the leaves, although sometimes they are laid on the upper side and then almost always just on the midrib. They resemble very much those of *Diatræa striatalis*, but are a little smaller and ordinarily arranged in three to five rows. Often one finds 50 to 75 together, and the total number produced by one female is from 200 to 240.

FIG. 11.—*Chilo infuscatellus*, full-grown larva—enlarged (after Zehntner).

The larvæ hatch after eight days and are about 2^{mm} long. They, as well as the full-grown larvæ, are light yellow and have five reddish longitudinal stripes on the back. (In *Diatræa striatalis* the freshly hatched larvæ have, besides other differences, a *transverse* stripe on each abdominal segment and the full-grown larva has but *four longitudinal stripes*, the median one of Chilo being absent.

The young larvæ penetrate in and between the sheaths of the leaves of young shoots. There they rest until they have molted four times and then penetrate transversely and a little above the vegetation point. Upon reaching the center the tunnel is directed in a straight line downward. Here the heart of the shoot is eaten out, and finally the stalk is attacked and its vegetation point destroyed, so that the growth of the shoot becomes impossible. In one shoot one finds often three to five borers.

When the larva is full grown it makes a horizontal gallery above the vegetation point, *i. e.* through the sheaths of the leaves. The dust is then removed—partly downward, partly upward. Thereupon the larva pupates and the pupa lies anywhere in the vertical gallery in which it is able to move itself.

The whole development is accomplished within the following periods: Egg state, 7 to 8 days; larval state, 38 to 42 days; pupal state, 7 to 8 days; total, 52 to 58 days.

GRAPHOLITHA SCHISTACEANA, SNELL.

This insect lays its eggs in a single or double row on the leaves and on the sheaths of young shoots. They also much resemble those of *Diatræa striatalis*, but are considerably smaller and very difficult to

[1] In German: Vegetationspunkt, Vegetationsspitze.

find. Their length is 1.25^{mm} and breadth 0.80^{mm}. One female lays 150 to 170 eggs.

The freshly hatched larvæ are grayish yellow, with a flattened, blackish head and pronotum, and a somewhat irregular longitudinal light-red stripe on the back. The full-grown larva is uniformly grayish with a yellow head.

The young larvæ penetrate at the base of the shoots in the quite young stalks and bore an ascending somewhat spiral-like gallery. Thereby they injure the insertions of the leaves, and, as a rule, destroy the vegetation point. Often the tunnel is continued in the youngest leaves of the shoots. In each shoot one finds ordinarily but one borer.

When the larva is full grown it makes a horizontal gallery through the sheaths of the leaves. The opening is closed by dust from the boring, a cocoon is made of the same material, and then the larva transforms to chrysalis.

The whole development of this borer is accomplished within seven or eight weeks.

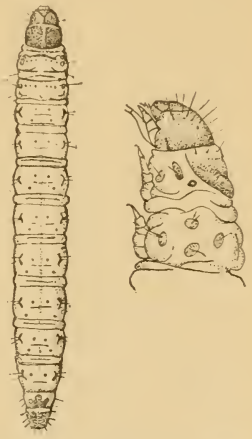

FIG. 12.—*Grapholitha schistaceana:* full-grown larva at left—enlarged; head of larva at right—more enlarged (after Zehntner).

REMEDIES FOR THESE BORERS.

As to the remedies for these four common Javanese borers, it is important to state that in the above recorded notes much attention is paid for the first time to the eggs of these insects. The knowledge of the egg's position is of great interest and it enables us to subdivide the borers into two groups, viz. Scirpophaga and Diatræa, on the one side, and Chilo and Grapholitha on the other.

The eggs of the borers of the first group are easy to be found and collected, while in the second group they are found but occasionally with Chilo, and only by a very careful examination of the cane with Grapholitha.

Moreover, the subdivision above mentioned agrees in some other features of the life-history of the borers, viz, Scirpophaga and Diatræa attack the cane in about three months after the seeds have been planted, and the damage by the young larvæ is to be seen *on the leaves long before they penetrate the stalks.* Chilo and Grapholitha, however, attack the young plantation in one month after planting. They damage the very young shoots by penetrating either directly into the stalk (Grapholitha), or between the leaf sheath and the stalk (Chilo), and, as a rule, the attack is only visible after the young stalks have already lost their growing point.

In consequence, the remedial measures should be arranged as follows:

About one month after planting, the plantation should be examined carefully and all shoots attacked by borers should be cut off. It is

very necessary to cut the shoots down to the ground (next to the seed) in order to be sure to remove the borer. The infested shoots can very easily be seen from a distance, their young, unfolded leaves becoming dry from one day to the following, and the cane being yet small.

If this examination is repeated two or three times a week for about two months, the Chilo and Grapholitha will be exterminated for the most part, and then it is just time to pay most attention to the Scirpophaga and Diatraea. With these borers, above all, *the eggs ought to be collected*. This is not so difficult as it might seem at first view. The method being once installed, we are sure that the borers of the first group can be exterminated for the most part in this way. In case the young larvæ are already hatched, we remember that they rest for a time between the young, unfolded leaves, and if the attack is observed in time the borers can be removed by cutting off the young leaves only. If the larvæ have already reached the stalks, these must also be cut off.

It is of the greatest importance to begin the remedial measures in the quite young plantation and to execute them with the greatest energy, so as to render unnecessary further work in the half-grown or still older cane. In this way the attack of the borers can be controlled, the second generation can be restricted to a minimum, the young plants can easily be examined, and the collecting of the eggs is much facilitated, and *enables us to save a great many shoots from being cut off*. If, however, the cutting off of shoots is absolutely necessary, there is but little loss of cane, since the shoots at this time are quite small. Moreover, there is much probability that the secondary shoots formed after cutting will soon equal the primary ones, and in this way the plantation becomes equal.

With the half-grown or older cane, thrashing is a partial remedy against borers as well as other insects. As to the full grown cane, the fields should be burned over as soon as the cane is removed.

TWO JAPANESE INSECTS INJURIOUS TO FRUIT.

By M. Matsumura, *Sapporo, Japan.*

APPLE FRUIT BORER.

(*Lavcrna herellera* Dup.?)

This is the most troublesome insect with which the fruit growers of Japan have to contend. It was probably introduced from some foreign country, and is now met with wherever apples are grown. It caused great damage during the year 1891, and is still doing much injury, especially in Hokkaido. It is a small moth which belongs to the Tineina, family Lavernidæ, and which resembles Coleophora in general appearance. The generic and specific names of this insect have not yet been determined with exactness, but its characters coincide with the description of *Lavcrna herellera* of Duponchel, as given by Dr. Oskar Kirchner,

of Hohenhein, in his "Krankheiten und Beschädigungen unserer landwirthschaftlichen Kulturpflanzen," with the exception that the labial palpi are not black-ringed.[1]

Imago.—Anterior wing long and narrow, and broadest near the base, with long fringes; ground color brownish gray, crossed by obscure, irregular streaks of gray and purplish shade; a darker streak starts from the base of the wing almost to its middle; the inner margin yellow or pale yellow, a half-longitudinal dash to the middle of wing, where 2 large black patches obscurely border on it; costal margin with many yellowish spots; outer margin with a large yellow spot near the tip of costal margin. Hind wing lanceolate, dark gray, with long fringes; head and thorax with many pale yellowish scales; antennæ long, with alternate black and yellow joints, the basal part large, being pale yellowish, with a tuft; abdomen dark gray, legs brownish gray, with yellowish wings; labial palpi long, color like the head scale. Wing expanse, 12^{mm}; body length, 5^{mm}.

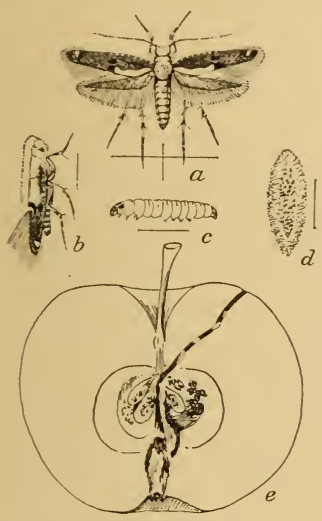

FIG. 13.—*Laverna herellera*; *a*, moth; *b*, same from side; *c*, larva; *d*, pupa in cocoon; *e*, apple showing work—*a–d*, enlarged; *e*, reduced (from drawing by author).

Season July; habit nocturnal, but light has no attracting effect.

Eggs.—I have not yet discovered the eggs of this insect, but the place where it deposits them is probably on the side of the apple, because the entrance of the larvae is easily recognized by a blackish spot at the side of the fruit after it has ripened; and it seems that usually only one egg is deposited on an apple.

Larva.—At first whitish, with black head; when mature, it attains the length of half an inch, and takes on a fleshy color with many obscure, brownish spots on each segment, from which a single minute hair arises. Head, first and last segments, brownish in color.

Larvæ live only in apple cores, injuring the seeds.

The larva matures in a month, when it measures about 7^{mm} in length. It makes a passage through the flesh of the fruit, and reaches the ground by letting itself down by a silken thread, or by crawling out soon after the fruit has fallen. In either case it makes a hole in the ground.

[1] An apple miner occurring in British Columbia has recently been reared by Dr. James Fletcher and determined by Lord Walsingham as *Argyresthia conjugella* Zell. This species, of which the writer has seen specimens through Dr. Fletcher's courtesy, is so like Professor Matsumura's figure of the species under consideration as to suggest that they may be identical and that the Japanese insect has already been introduced into British Columbia.—L. O. H.

Its only known food plant is apple.

Pupa.—When pupating it makes white cocoons in the earth, consisting of a double layer, the outer being like a mosquito net, but the inner being much as usual. It generally varies in shape from oblong to spindle form, measuring 6–7^{mm} in length, 3^{mm} in breadth. It always pupates in the earth, wherever it is possible to do so; but when the apples are packed in a box it pupates in it, and then it is carried any distance, hibernating in this state. It breeds once in a year, unlike the codling moth, the latter being two or more brooded in our country.

Preventive method.—In late autumn the ground under the affected tree should be thoroughly disturbed so as to expose the cocoon to the thawing and freezing action of the weather. As injured apples fall easily, a slight jarring will bring them down, almost all of them with insects in them, and these must be collected before the insects make way into the ground. The same precaution should be taken with the fruits which have fallen from a wind. All these fallen fruits should be kept in a strong box with a tight cover, leaving no opening or crevice; and these may be kept for family use, as they are alway sweeter than healthy ones, but they will not do for storing purposes. Such fruits as are not perfectly ripe are of use as food for swine, etc. Lump sugar is of no value, but block sugar in *Sake* solution, kept in a large-mouthed bottle placed upon a stand or hung from a branch, is available at night, but in daytime the bottle should be kept closed, because the beneficial insects, as aphidivorous flies (Syrphus, Paragus, Pipiza, etc.), seek the saccharine solution and may be drowned in it. The moths come late in June or early in July, when apples grow about one inch in diameter, so I doubt whether London purple, Paris green, lead arsenate, arsenious acid, etc., are safe to use or not; perhaps a certain portion of the poison used may remain to the time of ripening, and may become dangerous. Kerosene emulsion, benzole, nitrobenzole, or Quiebell's insecticide, etc., may be available, but I have not yet tried any of them. Imported apples should be very carefully examined and also the boxes in which they are carried, as the larvæ often pupate in a corner or crevice.

PEAR FRUIT BORER.

(*Nephopteryx rubrizonella* Rag.)

There are two species of Japanese pear borers, and the species under consideration is much larger than the other. In 1889 the smaller species (which is not yet named) was described by Mr. S. Ikeda, of the Agricultural College of Tokyo, in the Zoological Magazine (Tokyo, Vol. I, p. 99); but its life history was not known clearly at that time. By this larger borer our pear growers have been losing every year 30 to 50 per cent of their crops, it being a much more troublesome insect than the apple borer I have elsewhere described. Entomologically it belongs to the family Phycitidæ, and its generic and specific names were kindly given me by Dr. W. J. Holland, of Pittsburg, through the kindness of Dr. L. O. Howard.

Imago.—Antennæ curved over the basal joint, the latter with a scaly tuft; labial palpi compressed, with a long end joint; maxillary palpi small and filiform; anterior wing with 11 veins, branches 4 and 5 not being stalked; ground color varying from grayish brown to grayish black; crossed by two equidistant irregularly pinnated grayish bordered black lines; outer margin and basal half much deeper in color, with a black discocellular marking in the middle of the wing. Hind-wing dark gray with 8 veins, the first two branches being near each other; branches 3, 4, and 5 spring from a common stalk, which arises from a hind angle of the closed mid-cell. The thorax is of the same color as the anterior wing, abdomen much paler; hind tibiæ large and compressed, with 4 spines. Wing expanse, 25^{mm}; body length, 12^{mm}; 2 brooded in a year; first brood, middle of July, a second, late September to early October.

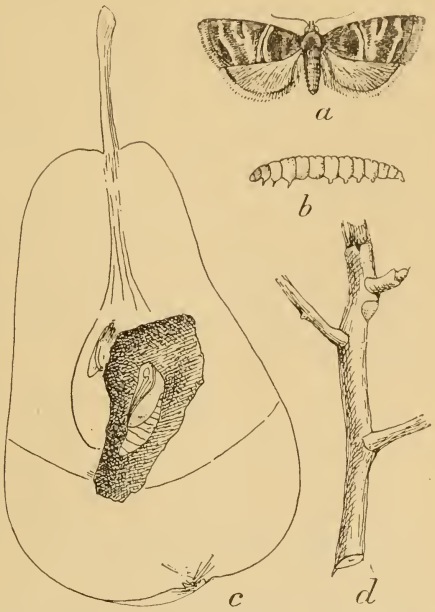

FIG. 14.—*Nephopteryx rubrizonella*: *a*, moth; *b*, larva; *c*, pupa *in situ* in pear; *d*, twig showing egg mass above at right—natural size (from drawing by author).

Eggs.—They are placed just under a small twig where the rain does not directly strike, protected safely by a white silk web. The eggs under that cover are about twenty in number, oblong in shape, both ends being a little narrower; very flat; black in color; 7^{mm} by 6^{mm} in size.

The species hibernates in this state.

Larva.—The eggs hatch in early June, at the time when the pear attains the size of a cherry. The larvæ at first spin much silken thread on the branches and then make their way to different fruits near by. Injured fruits are almost always attached by silken threads at that place of the branch where a fruit stalk hangs. At first pale white in color, with black head and blackish first segment, the larvæ gradually change in color to grayish yellow, and when fully mature they take a pinkish-brown color, and measure about 20^{mm} in length. They are spindle-shaped in general, and consist of 12 segments, of which the sixth, the seventh, and the eighth are longest; head brownish black; the upper part of the second segment with two pitchy-black horny spots; legs show nothing unusual. They injure only the core of pears, and as they leave always a large blackish opening at their entrance, it is easy to detect their presence. The larval stage lasts three weeks or more; the specimens which I reared made cocoons June 30.

Food plant, only pear.

Pupa.—It always changes to pupa within the core of the fruit, spinning very little silk. The pupa is deep red brown in color, head, thorax, and wing portion being much more so. It measures 13mm to 15mm in length. The pupal stage lasts more than two weeks.

Preventive method.—The most effectual preventive method is to take off the eggs during the winter months, as they are easily recognized by their whitish web cover at the branches. For this purpose pruning is indispensable, eggs being almost always on the tops of the branches, and when pruned they should be immediately burned. The remaining branches should be carefully searched. The eggs are always placed near the hibernating nest of the pear leaf-roller, *Rhodophæa hollandella* Rag. Kerosene emulsion is very beneficial after pruning as well as in early June, at the time of larva's hatching, for it kills at the same time the larvæ of leaf-roller. After the larvæ bore into the fruit no remedy is accessible except carbon bisulphide, but this chemical being very expensive I only used it on a dwarf tree, pouring it with a small brush into the hole through which the insect entered. It very soon killed the insect and no injury was done to the fruit. Now, in our garden, picking off the injured fruit by hand is the only means resorted to, as they are easily recognized by their black holes and their excrement. Lump sugar is of no use, but a sugar solution in *Sake* in any glass vial attracts them.

DESTRUCTIVE LOCUSTS IN 1897.

[Report of investigations conducted under instructions from the Entomologist.]

By W. D. Hunter, *Temporary Field Agent.*

Under commission dated July 27, 1897, and letter of instructions of the same date, I left Lincoln on the 3d of August, by the Burlington Railroad, for some of the western counties of Nebraska. The first stop was made at Benkleman, where I learned that much damage had been done in Dundy County in this and preceding years. From this point I proceeded to Denver, stopping at Haigler, Nebr., and at Yuma, Akron, and Fort Morgan, Colo., at each of which points collections were made and inquiries addressed to residents regarding locust devastations.

From Denver I worked up and down the foothills of the mountains through the most productive agricultural part of the State, making stops at Greeley, Fort Collins, Longmont, Colorado Springs, Manitou, Colorado City, and Pueblo. I proceeded from Pueblo to Grand Junction, stopping at Canon City, Salida, Glenwood Springs, and DeBeque between these places. Some interest attaches itself to investigations made in the Grand River Valley, the rich fruit-growing region of the State, on account of the damage done in the spring of 1893 to fruit trees by locusts, and the probability of a recurrence of it. Stops were made at Salt Lake City, Ogden, and Cache Junction in Utah; and in Idaho, Pocatello, American Falls, and numerous other places along the

Oregon Short Line were visited. Huntington, Oreg., which is rather outside of the farming district of the State, and Pendleton, in the center of the farming district, were then visited. A stop of some days was made at this point because of the reports received regarding damage done to wheat in this vicinity, on the Columbia plateau, in this and preceding years.

Only Walla Walla and Spokane Falls, in Washington, and two places in Montana, were visited. This resulted as much from being reasonably certain that this region was exempt from injury as from lack of time. On my return, stops were made at Sheridan, Wyo.; Edgemont and Deadwood, S. Dak., and at various points between Chadron and Lincoln.

After returning to Lincoln, numerous short trips were taken to different points in the State. Beatrice, Fairbury, Geneva, Columbus, Omaha, and Fremont were visited at this time.

The plan pursued was—

First. To visit personally as many districts as possible where known to be infested.

Second. To pass through and along the limits of the permanent breeding region, making short excursions within to ascertain the status of the Rocky Mountain locust (*Melanoplus spretus*) which, at the time of beginning this work, appeared to be in a condition of general awakening.

Besides the information gathered on this trip of investigation, I have used, in making this report, observations made and material collected on a trip through the northern and western part of Nebraska and eastern Wyoming in the interest of the Nebraska Experiment Station, during June; also a trip from Lincoln to Salt Lake City, on which many stops were made, in July; and on a trip to the Big Horn Mountains, 40 miles west of Sheridan, Wyo., also in July. These trips—one to the heart of the permanent region in Wyoming, another one completely through this region, 500 miles farther south, with the trip through Colorado to the south and Montana to the north—completed a reasonably exhaustive survey of the regions liable to injury and of the sources from which injury, if it is done next season, will spring.

Although the discussion of this question may not, in the nature of the case, be readily divided by States, yet, in the furtherance of definiteness as well as for convenience, I have so divided the subject. The summary at the close will, I hope, remove unintended impressions resulting from this method.

NEBRASKA.

The Rocky Mountain locust (*Melanoplus spretus*), hatched in the early part of April in this State along the Niobrara Valley, from Sioux County on the west eastwards nearly 200 miles to the vicinity of Bassett, and in the valley of the North Platte from the west boundary of

the State, in Scotts Bluff County, eastward to the junction of the North and South Platte. It was not found on the South Platte, except very sparsely between Ogallala and North Platte. With the exception of isolated points, notably Gehring, Crawford, and Ainsworth, this species was not, however, guilty of most of the damage that was at that time reported from that region. This area is within the subpermanent region, and the locusts that have done damage this season are of the swarm that entered in the fall of 1895. The natural tendency to become weakened and die out in this region has been counteracted by a series of seasons unusually favorable for their continuation. The result is that instead of dying out they have unexpectedly been on the increase, until this year they have attracted great attention.

It must not be understood that there has been a *spretus* plague in Nebraska this year, because such is far from having been the case. The same conditions that have caused the present aspect of affairs regarding *spretus* have brought about an immense increase of the native species. In the total amount of damage that has been done, the amount attributable to *spretus*, in comparison to that by native species, becomes quite insignificant. The truth is, however, that Nebraska has suffered more this season than in any season in the last ten years.

During the month of September *spretus* left the region where it hatched, in swarms. I was much interested to note a weak return swarm passing over the Black Hills, in South Dakota, on September 12, and have been at considerable pains to investigate this point further. I have been unable, however, to obtain any trace of other such swarms. Since there have been numerous swarms in the normal direction, and no one has informed me of any, nor have I observed any other than this one weak one. I consider that it does not change materially the aspect of the case.

Reference to the files of the Weather Bureau Station here sheds the following light on this exceptional, spasmodic return flight, as well as on the general southeasterly flight during the month of August. With the exception only of the 3d and 4th the wind in the region of the Black Hills was southeast and south, and only on two days as nearly toward the northwest as due northeast. The general direction for this month was decidedly toward the southeast. This condition prevailed the first six days of September. On the 7th, however, the wind changed to the north, and on the 8th it blew toward the northwest, and on the 9th south, but weak; on the 10th northwest; on the 11th, the day preceding this occurence, toward the northwest in this region and in all the surrounding country. There is no doubt that this wind will explain this flight and that the decidedly southeasterly direction of the wind—it blowing northwest only three isolated days subsequent in this month—explains the absence of other northerly flights and the noted southerly ones.

During the greater part of September loose swarms of the Rocky Mountain locust might have been seen in almost any part of the State

drifting toward the south. I have been unable to find traces of a new invasion from the north. The situation then at the present time is that the stock that did the damage last year has moved about 200 miles farther south, so that most of the State is covered. However, it has become weakened and spread so that, except in localities, the locusts will not, in my opinion, be heard of next season. They will cause damage less than was done last season in the eastern part of the Niobrara Valley and the South Platte Valley.

The native species have been numerous enough to do considerable damage in all of the western half of the State. The limit of damage coincides, practically, with the limit of the drought-stricken regions of the preceding years. The regions in which the damage has been most apparent have been the Niobrara Valley eastward as far as Neleigh, the North and South Platte, and the Republican as far eastward as Indianola, with many branches between these latter, and north of the North Platte. These regions have not, however, been uniformly affected. One county may be severely affected and the next one not at all. In short, this whole region is covered with areas of infestation separated by areas almost entirely exempt and these areas are not bounded by any natural obstacles.

A trip west and southwest from Alliance to Sidney by way of Gehring showed parts of the country affected so severely that grain and even the woody parts of plants were entirely destroyed, and the locusts were so numerous as to cover miles of fence posts, although this condition did not prevail everywhere. This damage was most severe near Gehring, although there was a large region south of that point that was apparently not affected. The region near Ogallala was almost devastated.

The same conditions were found in the Niobrara and Republican valleys. The almost universal dying out of the prairie grass, the favorite food of most of the species, has driven the locusts into cultivated land. In the vicinity of Benkleman I found a field of wheat that was so nearly destroyed that the owner had given up hope of harvesting it at all, but a walk of several hours across the adjacent prairies discovered only a few dozen insects until another field was reached.

It is truly astonishing to observe, when the conditions are such as these, that the farmers are so slow in being aroused to activity against these pests. Nature, it seems, has brought all their six-footed enemies together in small areas, and all there await destruction. All the locusts within a square mile may be collected on a few acres, as in the case mentioned, where a few hours' labor would destroy them all; then the idea that it is best to destroy them to prevent an outbreak next year is so remote that it is not usually acted upon. It is possible, I believe, to destroy this pest in Nebraska by the use of 'dozers at the proper seasons.

The areas noted above are about 180 square miles in extent, situated

about Gehring as a center; South Platte to North Platte (100 miles of the North Platte Valley before the junction with the Platte has been exempt), Chase, Dundy, Hays, and Hitchcock counties in Niobrara Valley, Chadron, and from Ainsworth to Neleigh.

The species concerned in the damage have been, in order of their abundance, the differential locust (*M. differentialis* Thos.), the lesser migratory locust (*M. atlanis* Riley), the two-striped locust (*M. bivittatus* Say), and the red-legged locust (*M. femur-rubrum* DeG.). The remarkable point in this connection is the scarcity of the long-winged locust (*Dissosteira longipennis* Thos.), which was very noticeable last year and was supposed to show indications of becoming very troublesome. It caused practically no damage except at one isolated point near Ogallala. An equally remarkable fact was the increase at some points of *Hippiscus corallipes* Hald., which, like *D. longipennis*, up to within three years was extremely rare, and is so recorded in Professor Bruner's list of Orthoptera published last spring. This large species was found at Sidney, North Platte, and some other points in abundance. It has never before been known to cause injury. *M. angustipennis* Dodge, and *M. fædus* Scudd., as well as other species of destructive tendencies have, as far as I have found, been at a standstill. In this State I found no fungus or bacterial disease abundant enough to affect the situation except locally. Tachinid parasites were extremely numerous at Culbertson, Sidney, and Indianola.

KANSAS.

The Rocky Mountain locust, *Melanoplus spretus*, was practically absent from Kansas this season, although some few specimens have invaded the northern part of the State and deposited their eggs during September. These will undoubtedly not be heard of next season.

In the western third of the State the valleys of the Solomon, Arkansas, and Cimmaron rivers have been generally affected by the non-migratory species, and the damage has been intensified in the northwestern and southwestern corners of the State along the tributaries of the Republican and the main valley of the Arkansas. During the month of September this latter region was affected so severely that application for help was made to the Kansas State board of agriculture at Topeka, and the University of Kansas has issued a bulletin on the subject. The counties that have been most affected are Rawlins, Decatur, and Norton in the northwestern part, and Hamilton, Kearney, Finney, Morton, and Grant in the southwestern part. The remainder of the western part seems to have been infested with scarcely more than the normal number of locusts. The reasons for this state of affairs are precisely the same as those for the conditions in Nebraska, and the pest might as easily be removed by proper means.

The species concerned are practically the same as those in Nebraska, *Melanoplus differentialis* doing at least three fourths of the damage,

except that *Acridium frontalis* Thos. was found injuring alfalfa and sorghum especially. The natural food of this species is the Helianthiæ, but in recent years the tendency to become adapted to cultivated plants, which has also been observed in the case of *Dissosteria longipennis* and other species, has been quite noticeable. It is worthy of note also that sorghum is taken in preference to most other plants, although I saw fields of alfalfa and millet rendered valueless by this species.

Melanoplus bivittatus was scarcely less numerous than *differentialis* in some places, but this does not contradict the above statement that three-fourths of the damage was done by the latter species. *D. longipennis* was occasionally met with. *Hippiscus corallipes* Hald. was not found.

The Arkansas Valley has been exempt from much injury for several seasons, but it is favorable weather conditions and the absence of parasites that have brought about the present state of affairs. The pests are increasing, and although they will not be much in evidence next year on account of the very natural increase of parasites, the trouble will not at least be augmented. Unfavorable weather conditions, such as freezing or a late or wet spring, may, however, noticeably diminish the number of locusts here. The preponderance of evidence points to the fact that the trouble is a permanent one, in spite of the aid given by parasites and meteorological conditions, or, at any rate, of frequent periodical occurrence, and that the work of the farmers and not the intervention of Providence is the only way out of the difficulty. Destruction is made easy by the fact that the locusts are collected in small areas, as has been indicated in the discussion of the situation in Nebraska. The parasites may be abundant one season in one of these areas, or may even practically exterminate the locusts infesting it, but do not easily spread to the neighboring fields, which may be 3 or 4 miles distant. Thereupon the locusts begin to increase again in this area, and this process is repeated continuously. The ready means of control of the pests by the farmers and the reasons why it is possible will be brought out more fully in the discussion of the conditions in Colorado, which are much the same.

COLORADO.

Rocky Mountain locusts (*Melanoplus spretus*) were practically absent from Colorado this season, although I collected a few specimens in the vicinity of Julesburg and at a point directly south of Sidney, across the Nebraska line in Logan County. Specimens were by no means numerous, and I have no doubt that they represent the extreme advance guard of the species. Professor Gillette informs me that he knows of no case of the occurrence of this species in Colorado in the past six years, adding, however, that most of his locust collecting has been done along the foothills. Certainly it has not been present during this season in more than a few counties in the extreme northeastern parts of the State.

The damage done by the native species reached its greatest extent

in the irrigated portions of Colorado and is due to easily explainable circumstances. The whole of the irrigated portion of the State, consisting of the valleys of streams descending from the mountains, has been seriously affected. The portion of the Platte Valley in the neighborhood of Greeley and the valley of the Arkansas in the vicinity of Las Animas seem, however, to have suffered most. Besides this irrigated area, a large portion of land along the eastern boundary of the State above the points to which water may be carried for irrigation has suffered to some extent. Early in May letters from this region stated that the indications were that everything would be destroyed. In a general way it is true that the whole farming territory of the State may be included in the territory very noticeably affected.

The species most concerned have been *Melanoplus bivittatus* Say, *M. femur-rubrum* DeG., *M. atlanis* Riley, *M. fædus* Scudd., and *Acridium frontalis* Thos., with a noticeable presence of *M. differentialis* Thos. in the eastern part of the State. The two first-named species were present everywhere, and in some places in almost incredible numbers, *bivittatus* doing probably three-fourths of the injury. In the vicinity of Fort Collins I often counted as many as 25 large, vigorous specimens of this species in a square yard along the roadside, and in some places they were even more numerous, as many as 40 being counted in more than one case.

The indications are that north of Colorado Springs *M. bivittatus* has done the most injury, and south of that point *M. femur-rubrum*. *M. fædus* was most abundant in the vicinity of Colorado Springs, but its damage was comparatively very slight. *M. lakinus* Scudd. was only observed here and in very small numbers. A sweep net full of locusts taken in this vicinity yielded 61 specimens, 30 of which were *M. femur-rubrum*, 8 *M. atlanis*, 8 *M. fædus*, 7 *M. bivittatus*, and the remaining 8 representing equally some harmless species. Further south and in the Arkansas Valley *A. frontalis* became more numerous, especially outside the region of the foothills toward the Kansas boundary.

A careful study of the situation in Colorado makes it evident that injury from locusts is an invariable concomitant of irrigation as at present practiced. Under the present conditions grass and weeds or grain spring up along the irrigating ditches and are allowed to stand. This results from two facts: First, it is necessary to cut the vegetation along these ditches by hand if it is cut at all, because in the immediate vicinity of the ditches the soil is too moist to admit the use of horse power. Second, it is generally supposed that allowing the vegetation to remain increases the efficacy of the ditch by preventing seepage. As to the first of these reasons it may be readily seen that the harvesting of a strip of grain or hay fifteen feet wide, which is the usual width of such strips, would easily repay the farmer because it is the richest growth in the whole field. It is thus altogether probable that the returns from these strips would be greater proportionately than from the remainder

of the field. It would also seem, in regard to the second of the above-named points, that the prevention of seepage by short-rooted annual plants or even alfalfa would be slight and would be more than repaid by the profits on the grain or hay harvested along the ditch. However, it is the practice, with only very rarely an exception, to allow these spaces to grow up to weeds. In these extremely damp places it is not to be wondered at that species of locusts with such habits as *Melanoplus bivittatus* become exceedingly abundant and troublesome. In fact, these strips are the starting point of such a number of locusts that in this region the total acreage is much affected. They hatch in the spring and spread over the fields, then when the grain is cut, are driven back to the sides of the ditches, from which place they spread to deposit their eggs in the fall. It would be the simplest of matters to exterminate them, even though the practice of leaving strips along the sides of the ditches were not given up, by the thorough and persistent use of "dozers" after the grain had been cut from the fields. In short, all the locusts in the country are driven at this time to the sides of the irrigating ditches, and no doubt at that time a process of driving by means of beating of the locusts, which is very easily accomplished, from the inside of the fences to the outside and the drawing of "dozers" along the roadsides with an analogous process applied to the ditches would result in the destruction of all of them. For this purpose a modified "dozer" drawn by a horse attached to one side would be of best avail. The expense compared to the present annual loss would be very slight, and should be borne by the counties in the infested areas. If this is not done damage will result in the future just as certainly as the seasons recur as long as the present method, or lack of method, is in vogue.

One of the most valuable observations made in the territory most infested was the presence of immense flocks of Brewer's blackbird (*Scolecophagus cyanocephalus* Wagl.) hovering along the roads and destroying immense numbers of the locusts. Several birds obtained from a flock in the vicinity of Fort Collins had their stomachs crammed with from 30 to 50 specimens of these insects. The grasshopper fungus disease, *Empusa grylli* Fres., and Tachinid parasites were most numerous in the vicinity of Greeley. However, these attacks are rather local, and they do not seem to affect the local situation, especially since the flies do not appear until the locusts have done most of the damage which they are capable of doing.

In the western part of Colorado an unexpected and dangerous find was made in the presence of *Acridium shoshone* Thos. in the Grand Valley above Grand Junction. This species has not been found in this region before, though it has been known to infest adjacent parts of Utah. It was only seen in the Grand Valley bottom near DeBeque, and was feeding upon willow. It was present nowhere in injurious numbers and was not discovered upon fruit trees. It is an arboreal species, and under the conditions, which appear to be very favorable for

its increase, may do great injury if it attacks fruit trees, as it undoubtedly will. Almost the sole industry of the people of this valley is fruit raising, and if this species becomes abundant it will cause great trouble.

Several years have elapsed since an orthopterological survey has been made in this region, which has suffered at least once in the past and is liable to, again in the future. I found that no damage of any consequence had been done since Professor Bruner's visit in 1893, though the table-lands, mesas, and foothills harbor a number of species which may cause injury at almost any time. Such species are *Melanoplus atlanis*, *M. bivittatus*, *M. differentialis*, and *Pezotettix chenopodii*. The last-mentioned locust was the most conspicuous, and at one point, 20 miles north of DeBeque on Clear Creek, had destroyed a field of alfalfa of small extent. This was the only case of damage that came to my notice.

UTAH.

This State was not affected by the Rocky Mountain locust this season. Specimens were found near Salt Lake City, in the Big Cottonwood Canyon, on the tablelands eastward, and in the immediate vicinity of Echo in the valley of the Weber River. A few were also taken in a waste field adjoining the railroad track at Cache Junction. In this State neither was any great damage done by the native species. Inquiry of farmers long residents of this region invariably brought out remarks concerning the great devastation experienced in 1871, which was the only one in that region that they seemed to know anything about. No information came to me either from the officers of the experiment station at Logan, the State fruit-tree inspector at Salt Lake City, from a careful perusal of the files of the State papers, nor from the numerous residents who were questioned, that there was any damage done this season.

I found in the vicinity of Ogden two fields of alfalfa which had been partially destroyed by *Melanoplus atlanis* Riley, but the owners had taken prompt action in the matter and had effectually overcome the pest.

Acridium shoshone Thos. was found damaging prune trees to a slight extent near Salt Lake City, at Provo and Echo. These are the sole cases of damage that have come to my notice, and are of very little importance.

Information reached me that hordes of *Anabrus simplex* were marching down one of the tributaries of the Provo River in the neighborhood of Park City and had done considerable damage. In that region such an occurrence is liable to take place almost any season, but the reports were so conflicting that it was not deemed best to make a special journey on this account, since it is not an agricultural region.

It is somewhat difficult to understand why it is that the irrigated regions in Utah, which are in a situation practically analogous to similar regions in Colorado, and in which the meteorological conditions are

much the same, have not been severely damaged by the native locusts, as has been the case in the latter region. The explanation, it seems, lies in the more thorough system of cultivation and in the practice of cutting the grass along the irrigating ditches, though probably several other factors have combined to bring about the result.

IDAHO.

Specimens of the Rocky Mountain locust were captured at Pocatello and at American Falls. In the table-lands west of Pocatello and to the left of the Port Neuf River numerous specimens of *spretus*, which had bred in the valley, were found collected and preparing to migrate. A strip about one-half mile wide by nearly a mile long was practically covered with them. The 1st day of September, the wind having been unfavorable for several days, but having now changed, they arose and, collecting in a rather compact mass, disappeared in a northeasterly direction. After they had left, where thousands had been seen before not one was to be found. Search was made for eggs, but none were found; nor were any females seen in the act of depositing them. The only subsequent trace of this swarm that I have been able to find was conveyed in the information given me by a ranchman who came from near Eagle Rock. He stated that on the same day (September 1) he had seen a swarm of locusts a few miles north of Blackfoot, passing to the northeast. Probably the destination of this swarm was the headwaters of the Snake River, in northwestern Wyoming. They caused no damage in the vicinity of their starting point, for it was not an agricultural or a grazing country, and it is not probable that they reached a country in which they could do much damage. It is altogether likely that this swarm, which was the only one at all of formidable proportions, will be heard of next year, though its present whereabouts is not known.

The native species have not been much in evidence; the only case of damage was reported from near Nampa, and was caused to young prune trees by *Acridium shoshone*. They had been damaged, it was said, to the extent of several hundred dollars.

At various times information as to hordes of western crickets (Anabrus) was reported to me while passing through this region. They had reference in most cases to inaccessible regions, and were not in many cases to be relied upon. One of these reports came from Hailey, but I have received information of a rather contrary character from the residents. Another report of the same nature came from Challis.

OREGON AND WASHINGTON.

These States were not included directly in my letter of instructions, but reports of damage in accessible points led me to visit certain localities in the eastern portion of them. From reports given me by residents, it appears that for the last three years the wheat growers, especially in Wasco, Umatilla, Union, and Baker counties in Oregon, and

Yakima, Franklin, Adams, and Whitman counties in Washington, have suffered to a great extent from devastations by locusts. The vicinity of Ritzville seemed to have suffered most of all. Mr. A. S. Newton, of that place, informs me that for two years the total acreage of wheat has been injured to the extent that only half a crop has been harvested.

Melanoplus spretus was taken at all points in this State where stops were made, but in rather few numbers. However, in the northern part of Adams County, in Washington, it was the sole species concerned in the damage.

M. femur-rubrum has done by far the greater share of the injury, though *M. atlanis* has also been very numerous. The injury that has been done by these species in these regions has been as great as has been done in any part of Colorado during the past season, though the conditions are entirely different in the two regions. Parasites, mites, and *Tachinidæ* were very numerous and were fast decreasing the number of locusts. In many cases this abundance, with an extremely wet fall, will have the effect of materially decreasing the number of locusts appearing next season. Early in September the rainy season began before much of the wheat was cut, and prevailing cold rains continued for several weeks. This was just in time to interfere with the depositing of eggs, and furthermore had a very demoralizing effect on the locusts. Large numbers were found huddled together, many dead, and the remainder weakened by the cold and attacks of fungus diseases. These fungus diseases, if it were not for the cold, would have spread to such an extent as to exterminate the pests. Conditions here are so entirely different from those in Colorado that it is safe to say that the pest is on a decline, although it will by no means have disappeared by next season. Professor Cordley is of this same opinion.

In Oregon several localities in the Grande and Umatilla valleys have suffered in the past few years from crickets, but, as far as I could ascertain, not this season. There was one such case last year near Seneca and another near Pilot Rock.

MONTANA.

The only stop made in this State was at Helena, where, a few miles up the Last Chance Gulch, several specimens of *Melanoplus spretus* were collected, the only species of Orthoptera in evidence. I was informed by Mr. A. I. Sanderson, of Helena, who has traveled in all parts of the State this season, by wagon from Miles City to Livingston, that he had not seen or heard of an undue prevalence of locusts in any part of the State. Mr. P. A. Rydberg, agent of the Division of Botany, who in July and August covered thoroughly the region between Bozeman, Livingston, and Yellowstone Park, reported that the number of locusts seemed less than in previous years when he had traversed the same territory. A well-informed ranchman from the valley of the Madison,

where, if at any place in the State, *spretus* would probably be found, informed me that during his residence of six years in that vicinity he had not heard of any damage whatever being done by locusts.

WYOMING.

Specimens of Rocky Mountain locusts (*Melanoplus spretus*) were collected at Sheridan, Cheyenne, Rawlins, Green River, and Evanston. The only one of these districts in which they were overnumerous was near Sheridan on the foothills of the Big Horn Mountains, where an area of something like 200 acres was almost covered with them. This was early in September, and they were preparing to deposit their eggs. Lack of time prevented ascertaining whether other isolated areas in this region were similarly affected. However, from the reports that I invariably received from residents, I am brought to believe that along the foothills of the Big Horn Mountains there are areas, like the one mentioned above, in which *spretus* has hatched in the past few years in great numbers. I think that here is the origin of the swarms that have in previous years invaded portions of South Dakota and Nebraska.

M. atlanis was numerous at Evanston in company with *femur-rubrum*. I found these species destroying the range grass near Douglas, as was the case in the adjoining regions of Nebraska. They did not reach far west of that point.

Anabrus simplex, or a nearly allied species of Western cricket, was reported as very numerous by a ranchman who rode into Sheridan from a point near the mouth of Shell Creek in the Big Horn Basin. He said that he had seen droves of them collected on the banks of the above-mentioned stream preparing to cross to the south. I was unable to obtain specimens, and could gather no further information on this point.

Generally, this State seems to have been but very little affected. I am informed by the officers of the Experiment Station at Laramie that no cases of damage have been reported to them this season. The only important observation is in the appearance of *spretus* in considerable numbers west and north of Sheridan.

SOUTH DAKOTA.

The situation in this State regarding *Melanoplus spretus* has been more serious than elsewhere. It was impossible to visit the counties most seriously affected, but Mr. Saunders, of the Experiment Station at Brookings, has given me reliable information on this point. Report was received early in June from Mr. H. S. Wright, of Chamberlain, stating that the farmers were very much excited by the prospect of much damage being done by the young locusts which had just appeared. From this source and from other information received it seems that more than the western half and a few of the northeastern counties have been affected. The valleys of the Moreau, Cheyenne, and Missouri rivers have been affected in the same manner as regions in Nebraska;

i. e., in isolated areas. Most attention has been drawn, however, to the several counties near Sphinx County and a region about Chamberlain, in Brule County, as a center.

M. spretus was responsible for the larger part of the injury. Strict measures were taken by Mr. Saunders, especially in the former regions, and he reports that he has succeeded in checking the pest to a large extent. The origin of these South Dakota swarms has been accounted for. They arrived early in September last year from northeastern Wyoming and were assisted at that time by favorable winds.

As in Nebraska, native species have been very numerous and have occurred indiscriminately with *spretus* at all points. *M. femur-rubrum*, *M. atlanis*, and *M. differentialis* have been represented about equally.

My personal investigation in South Dakota was confined to the Black Hills, which is the only portion of the State easily accessible from Lincoln by rail, and was undertaken mainly on account of a newspaper article under date of July 15. This article stated that a large region had been overrun by locusts to such an extent that ranchmen were compelled to move their herds to other places and that all crops were being destroyed. Regarding this, I have to report that the statement was entirely without foundation. Several reliable observers who have been stationed in the Hills state that this report was noticed and commented upon by the people of the Hills, and that this was the first intimation that they had received of such an occurrence. Mr. F. D. Burr, of Lead City, and Mr. A. S. Pearse, of Deadwood, both of whom traveled in all parts of the Hills during June, July, and August, report that no cases of damage came to their notice. I consulted newspaper men, traveling men, and tourists by dozens and found that none of them had seen any damage done in the Hills. Mr. M. C. McCain, of Rapid City, gives me the best account of the situation in this part of South Dakota; it is appended to this report. I was unable myself to find any species of Orthoptera abundant here. Only one-half dozen of *spretus* near Edgmont were taken and other species were correspondingly scarce.

It thus appears that, excepting the Black Hills and the southeastern part, the State has been locally affected, and very severely in some cases. Unless swarms of *spretus* have come in from the Big Horn Mountain region, which I have been unable to ascertain, but which seems improbable, the situation in South Dakota next year is very easily forecasted; *spretus* will be a great deal less abundant, though the native species will be as numerous as they have been this season.

SUMMARY.

Regarding the Rocky Mountain locust.—There was, this season, a general activity of this species throughout the permanent breeding region greater than for any time for many years. This was brought about by a series of dry years, which have resulted in the abandonment of farm-

ing in many places. There has been an astonishing exodus from these regions of settlers who must be convinced by painful experience that the promises of spring are liable to give way to desert-like dryness in summer. It is, of course, well understood that the absence of serious damage since 1876 has been partially due to the settling up of the valleys in the permanent region. The abandoning of large parts of this region thus seems to have a definite and easily explainable relation to this occurrence. I wish to make it clear, however, that the dryness is the primary and the abandoning a secondary cause.

The species has been present in general in northeastern Wyoming, the larger part of South Dakota, and northern half and western third of Nebraska. In some of these regions, especially in South Dakota, the situation became very serious indeed.

The swarms mentioned, with the exception of the one in the Snake River region, have moved southward about 200 miles, and naturally on account of their sojourn in the subpermanent region under unfavorable conditions have become weakened, as shown by the return flight. There has been no fresh invasion from the permanent regions. Therefore this species will occur in South Dakota, Nebraska, and northern Kansas next season, but the damage will be less noticeable than that done this season.

Regarding the non-migratory species.—The past season has been one of unusual abundance and of consequent damage in South Dakota, Nebraska, and parts of Oregon and Washington; the normal amount of damage in Colorado and of less than the normal amount in Wyoming and Montana. The species concerned are numerous and the conditions so diverse that it seems hazardous to make a general statement regarding the situation next season. However, I believe I may state that it seems certain that the exceedingly damp season in Oregon and Washington, interfering with egg depositing, and the abundance of parasites will reduce the number of locusts materially. In Kansas and Nebraska the effects of a wet spring have been counteracted by the opposite effect of a favorable season for egg depositing. Hence, allowing for the natural increase of parasites, the situation here next season will be neither better nor worse. In Colorado the situation will be the same next year and further, as long as present practices persist.

Acridium shoshone Thos. has been found increasing in the fruit-raising district of the Grand River Valley in Colorado.

Dissosteira longipennis Thos. has not kept pace with the other species, and it appears that the former seeming indications of its becoming important are not to be fulfilled.

Hippiscus corallipes Hald. has become numerous enough to cause damage, and seems to be on the increase.

INSECTS THAT AFFECT ASPARAGUS.

By F. H. Chittenden.

Since the preparation for publication in the Yearbook of the Department of Agriculture for 1896 of the writer's article entitled "The Asparagus Beetles," observations have been continued on these two species of Crioceris, particular attention being directed toward *C. 12-punctata*, as its life economy has not been fully understood. Such other species of insects as have been observed on asparagus in the present as well as in past years have also received attention and the results are embodied in the present paper.

Few imported plants enjoy so nearly complete immunity from the attacks of native insects as does asparagus. Its foliage is sufficiently succulent and palatable to suit the taste of many insects, but it is not apparently preferred to other older and more natural food plants. Such insects as have been found feeding upon this plant appear to eat it with perfect relish, and several species are of almost constant occurrence in asparagus beds wherever the plant is cultivated.

In the preparation of this article an effort has been made to include every species of native insect that is known to attack the asparagus, and it embraces some few brief references to European species that infest this plant, as it is from the insects that feed naturally upon asparagus that we look for troublesome forms.

THE COMMON ASPARAGUS BEETLE.

(*Crioceris asparagi* Linn.)

The time of earliest appearance of this species in a locality, appears to be directly limited to its food supply. Thus, during the spring of 1897 it was not found at Cabin John Bridge, Maryland, until the appearance of the asparagus shoots in the beds in the last week in April; and larvæ, just hatched, were not noticed till the second week of May, while the same week larvæ nearly mature were observed at Suitsville, Md., both localities within five miles of the District of Columbia. At Suitsville the first adults of the new brood undoubtedly appeared in May, and under ordinary conditions this brood appears during the latter half of the month in the latitude of the District of Columbia. The beetles disappeared for hibernation some time in September.

It was noticed this year that, although the eggs are deposited chiefly upon young and tender plants on all parts of a plant, oviposition apparently occurs early in the season and upon later young growths, in which respect it differs from *C. 12-punctata*, and that the unopened buds are the favorite place for egg deposit. Often a bud is found with a single egg upon it, and more often a row will extend from this down the bud-stem. As many as eleven have more than once been observed in these rows. It is not a normal habit to place one egg upon the end

of another, but this not infrequently happens. Much less frequently the eggs are deposited on other portions of the plant—the main stem, branches, and leaves. Eggs, it is well known, will be placed on market shoots when other portions of the plant are not available for their reception.

PREDACEOUS ENEMIES.

In the Yearbook article, in the chapter on "Natural checks," the writer called attention to the fact that, for some unexplained reason, authors of economic articles in entomology had paid no notice to the natural enemies of the asparagus beetles, only a single species, doubtfully believed to have been *Myobia pumila*, having been recorded as attacking *Crioceris asparagi* in this country prior to the year 1896.

Observations conducted in the neighborhood of Washington indicate that the natural enemies of this species have practically no effect on the first generation of larvæ.

The spotted ladybird (*Megilla maculata* DeG.), during the season of 1896, was found to have been the most effective destroyer of asparagus-beetle larvæ; in fact, it was chiefly through the abundance and activity of that ladybird that the last observed generation of asparagus beetles was apparently killed off upon the grounds of the Department. The present season *M. maculata* was rarely met with, while the convergent ladybird, *Hippodamia convergens*, that had been rare the previous season, occurred in great numbers, and appeared to have killed off the *asparagi* larvæ of the first brood on the Department plat in the same manner that the other ladybird had done the year previously.

In the course of rearing the larvæ of *M. maculata* observations on periods in the development of the species were made. One individual was found to have pupated at 8.30 a. m., August 4, having the appearance of having transformed at least an hour earlier. August 7, at 9 a. m., the adult was found almost fully colored, evidently having transformed several hours before, indicating the minimum period at a little less than three days. A second pupated August 5 in the afternoon, and was found transformed and fully colored on the morning of the 8th. A third had not transformed to pupa at 5 p. m. August 5, and the adult insect, fully colored, was found at 3.30 p. m. August 8.

The beetles appear occasionally to eat the pollen of asparagus.

The convergent ladybird (*Hippodamia convergens* Guer.).—A larva of this species taken on the morning of August 1, 1896, devouring a Crioceris grub on the Department grounds, transformed to pupa August 6, and to adult on the morning of August 8, the pupal period having been less than three days. Temperature 85 to 92° F.

Collops 4-maculatus Fab.—In several lots of asparagus beetles received at this office this little malachiid beetle was present. It was to be seen on every bed of asparagus that came under our observation, and always, too, when the asparagus beetles bred most plentifully, but

in spite of the closest observation could not be detected attacking the Crioceris. In confinement the Collops beetle feed freely on both larvæ and eggs of Crioceris.

The bordered plant-bug (*Stiretrus anchorago* Fab.).—An individual of this pentatomid, perhaps three fourths grown, was taken August 1 at Marshall Hall, Md., with a Crioceris larva transfixed upon its proboscis. Others were seen upon the asparagus, and one kept in confinement fed voraciously upon the larvæ of the asparagus beetle and those of *Galerucella luteola* Müll., the imported elm leaf beetle.

August 4 the captive specimen, after having devoured two Crioceris larvæ, was supplied with another upon a spray of asparagus. After abstracting all the juices from the larva it at once sunk its beak into the asparagus. While engaged in this operation an elm leaf-beetle larva was inserted, which the bug found almost as soon as it withdrew its proboscis from the asparagus.

This species appears to have a predilection for coleopterous larvæ. On the Department of Agriculture grounds the writer has seen it preying upon the larvæ of the Colorado potato beetle, and Townend Glover noticed the same thing upwards of twenty years ago. The same writer observes of this species, which he mentions both as *diana* and *fimbriatus* (Report Comm. Agr. for 1875, pp. 118, 119), that it was found in Maryland busily employed in killing and sucking out the juices of the squash ladybird (*Epilachna borealis*). The writer has also seen this bug preying upon the larvæ, and Mr. E. A. Schwarz has observed it attacking the pupa, of the elm leaf-beetle in the open.

The spined soldier bug (*Podisus spinosus* Dall.).—Among the twelve-spotted species brought to this office from Oxon Hill, Md., was a larva of this species. It was kept in the jar with the beetles for a few days, and was seen with a beetle suspended from its beak. This bug was often seen on asparagus destroying the larvæ of the common asparagus beetles by impaling them on its proboscis and sucking up their vital fluids.

It is somewhat surprising how an insect so slow of movement as is this soldier bug can capture much more active species. August 2 an individual was seen at Marshall Hall, Md., with the adult of *Disonycha glabrata*, a flea beetle that commonly infests the pigweed.

Polistes pallipes St. Farg.—Different individuals of this wasp had been noticed flying about the asparagus plants on the Department grounds during July. On the 28th of this month a wasp was seen with a nearly grown larva in its mouth, and a second individual was watched as it flew leisurely about the infested plants in search of a larva. This found, the wasp seized it in its jaws and flew away. A third wasp seized a larva near the anus that clung tenaciously to the plant and required a considerable effort for its dislodgment. Subsequently other wasps were noticed in various localities preying upon the larvæ, which

they usually chewed up before flying far. The Department asparagus patch was seldom free from the wasps, which never left the plants without securing a victim.

Nehallenia (*Agrion*) *posita* Hagen.—Specimens of this little dragonfly were noticed during July flying about Crioceris-infested plants, and one that was watched flew into the asparagus patch and seized a small larva and flew off with it.

Calocoris chenopodii, a European capsid bug, has been noticed by H. Lucas (see Insect Life, Vol. I, p. 61) sucking the larva of *Crioceris asparagi* in France. *C. rapidus*, a common native species, is not uncommon in asparagus beds here.

Myobia pumila, Macq., a European tachinid, appears to be the only parasitic enemy known to affect Crioceris. It develops in the Crioceris larva, but is not known to occur in this country. In Europe it is believed to be an important factor in reducing the numbers of its host (l. c., pp. 62, 63).

THE TWELVE-SPOTTED ASPARAGUS BEETLE.

(*Crioceris 12-punctata* Linn.)

This species did not appear at Cabin John, Md., until the first week of May, a week later than the common species, and even then was found in only small numbers. This may or may not have any significance, but it is not improbable considering the habits of these beetles that the common species is habitually the earlier arrival.

The egg and oviposition.—In previous years nothing was learned of the oviposition of this species. Captured beetles refused to lay when confined for the purpose, and the eggs could not be found in the field. The present year yielded better success. Eggs were not found until nearly a month after the first appearance of the beetle, and it is possible that the beetles wait some time for the development of the berries before depositing on them, since the first eggs were observed May 31. These were laid on their sides in a vial in which a female had been placed. Subsequently eggs were obtained in jars containing fresh sprays of asparagus, and still later in the experimental beds connected with this office.

The eggs are deposited singly and by preference upon old plants, toward the ends of shoots which lower down bear ripening berries. They are always attached along their sides instead of at one end, as is the case with *C. asparagi;* not infrequently by two sides, so that the egg lies between two leaves; but more often they are attached along one side only. The total number deposited by a single individual is probably the same, as is also the number deposited at one time of deposition. A female kept over night had deposited 9 eggs, evidently all within a short time of each other, judging by their appearance. One

female was seen in the act of oviposition just before dusk and another one in the morning.

The egg of *Crioceris 12-punctata* is of about the same proportion as that of *C. asparagi*, being just perceptibly more than 2½ times as long as wide, but it differs in being nearly smooth and shining, without apparent sculpture (as viewed under a moderately high objective), and in being pointedly rounded at each end. It is attached to the plant at its side and at the side or sides of attachment is more or less flattened and roughly rugose, according to the shape of the plant where it is attached. In color it is nearly the same as *asparagi*, but a shade lighter. Length, 1 to 1.1^{mm}.; width, 0.4^{mm}.

In the accompanying illustration the egg is shown much enlarged on the left, and natural size upon the plant at the right.

The egg when first laid is milk white, with a yellowish tint, but it soon afterwards takes on a greenish shade which later changes to brownish olive. The eggs of this species appear to require longer for attaining full coloring than is the case with *C. asparagi*.

FIG. 15.—*Crioceris 12-punctata*: egg, natural size, on asparagus leaves at right; same, enlarged, at left (original).

Notes on the insect's life habits.—A larva, nearly full grown, was found crawling rapidly about on the office experimental bed June 16, at 10 a. m. It was provided with a sprig of asparagus bearing berries, and a quarter of an hour later was working its way into one of them. The following morning it was found to have entered the berry. Twenty-four hours later it had almost completely hollowed out the berry, and a a fresh one was given it. At 12 o'clock, or two hours later, the larva had issued from the first berry and a noticeable increase in its size was apparent. An hour later it entered the earth, showing it to have been full grown.

The bud was now examined, and only the rather thick outer skin, the stem, and a portion of the pulp, all of which had been masticated and evidently passed by the beetle, remained. In the single day that the larva had worked upon this berry it had entered, excavated, and evidently devoured its entire interior, having broken down the cell walls and eaten the six seeds and chewed up and probably swallowed the pulp, leaving nothing but the skin and stem.

A larva that had left an asparagus berry found at Cabin John, Md., June 7, had formed its cocoon June 16. For three days it was noticed still in the larva form. June 21 it had transformed to pupa, and on the 30th the imago appeared. A second larva, from the office bed June 18, entered the earth soon afterwards, and the beetle was found trying to cut its way out from its cocoon July 3.

The normal date of appearance of the first new generation cannot be given, but about Washington it is some time in June, and perhaps as early as June 15 in earlier seasons than the present.

Periods in the insect's life cycle.—The experimental plats at the Department were not a complete success, and as a consequence experiments on them were not entirely satisfactory.

The first beetles liberated on these plats were either not satisfied with their surroundings or were molested and left, and attempts to rear the species in confinement were only partially successful. The egg period is without doubt the same as that of *C. asparagi*, as is also that of the pupa, but the larval period can only be conjectured. Eggs that were laid June 21, in moderately cool summer weather, hatched June 26, or in five days.

This beetle evidently goes into hibernation at about the same time as the common species, i. e., some time in September, as no specimens were to be found upon the plants when searched for during the latter part of that month.

The species feeds normally on the berry.—The adult beetles are injurious to asparagus by eating the heads of the young growing shoots in early spring and perhaps occasionally attack the foliage and stems, but aside from this do not, in the writer's experience, attack any portion of the plant but the berry when this can be obtained. The newly hatched larva, it is presumed, crawls from the egg to burrow into the nearest berry, and leaves this again only to enter another. The berry drops off soon after the larva enters it, and the first generation of the beetle matures long before the berries redden on the plants.

There is obviously little danger of this species being troublesome, except perhaps to seed-growers, from its attack on asparagus berries, as the plant bears quite a crop of fruit after the beetles have gone into winter quarters.

Two European beetles, very closely related to the twelve-spotted asparagus beetle, feed upon this plant. These are *Crioceris 14-punctata* Scop., an inhabitant of western Europe, and *C. 5-punctata* Scop., which occurs in France, Germany, and Russia. Neither of these appears to be injurious in their native homes, and would not be likely to prove troublesome if imported into America, as they probably have the same habit as *12-punctata* of living upon the berries.

The larva of the European cockchafer (*Melolontha vulgaris* Fab.) is said to injure asparagus roots.

THE TWELVE-SPOTTED CUCUMBER BEETLE.

(*Diabrotica 12-punctata* Ol.)

Next after the asparagus beetles and the ladybirds this is the most abundant species on asparagus. It occurs on this plant everywhere and throughout the season, but is more frequently to be met with early in the year while the flowers are in full bloom and before the blooming of the favorite food plants of its adult stage—cucumbers, squashes, and the like—but in the latitude of Washington returns again with the later flowering of asparagus, which this year was most noticeable in new shoots in the latter part of July. It has an especial fondness for the blossoms, which the beetles gnaw into and devour.

LEPIDOPTERA FOUND ON ASPARAGUS.

What is true of other insects found on asparagus is particularly true of the caterpillars that have come under the writer's personal observation. None of the various species that have been observed occur in any number, and evidence is wanting to show that any have bred from the egg and lived upon the plant through their successive molts to maturity. Many of the species that will be mentioned, however, undoubtedly are able to breed upon this plant *ab ovo*, and probably do so. Such lepidopterous eggs as have been found upon asparagus have been placed on our experimental beds, but always with negative results, the larvæ migrating sooner or later. Very young larvæ were not reared, as it was not deemed matter of sufficient importance to justify the time and trouble.

The following list includes only caterpillars of moths:

The sulphur leaf-roller (*Dichelia sulphureana* Clem.)—The larva of this tortricid was found in tube-like silken cases composed of asparagus leaves and webbing May 31, 1897, at Cabin John, Md., and subsequently in September near Tennallytown, D. C. From the latter lot a moth was reared October 4.

One of the larvæ from Cabin John died in its web. June 16 a parasite was found to have issued from it and spun up its cocoon, from which the adult issued June 24. It has been identified by Mr. Ashmead as *Rhyssalus atriceps* Ashm.

Mamestra legitima Grote.—Larvæ were found on asparagus at Marshall Hall, Md., October 12, 1896. A specimen that was captured and fed upon asparagus entered the earth and formed a cell for pupation November 2. This species has been recorded by Mr. F. M. Webster to feed within the seed pod of *Asclepias incarnata* (Insect Life, Vol. II, p. 382).

Prodenia commelinæ S. & A.—A full-grown larva was taken on asparagus at Colonial Beach, Va., August 9, 1896, but perished of a bacterial disease. Eggs of this or an allied species were found upon asparagus in the city of Washington August 10. They hatched the following day, and a portion were placed on asparagus on the Department beds, but were not reared.

Prodenia lineatella Haw.—A larva about one-third grown was brought in from Berwyn, Md., August 8, 1896, by Mr. Frank Benton, who found it on an asparagus plant. A still smaller larva, not more than one-fifth grown, was found on the asparagus beds on the Department grounds, September 25, 1896. It died the following day, evidently of the same bacterial disease that had destroyed its congener.

The corn-ear worm or boll worm (*Heliothis armiger* Hbn.).—This most omnivorous of caterpillars was seen September 28, 1896, at Marshall Hall, Md., freely feeding on the foliage of asparagus.

The ground color of the asparagus-feeding specimens was a rich dark green and afforded considerable protection to the caterpillars from the lack of contrast to their food plant. Otherwise the markings were the same as for the flesh-colored and purple-hued individuals that feed

internally upon corn, tomatoes, beans, etc. Obviously we have in this species an external and an internal-feeding color variation.

The smeared dagger (*Acronycta oblinita* S. & A.)—A larva three-tenths of an inch long, Washington, D. C., July 1, 1897. The following day it molted and was kept for some time feeding on asparagus, but no attempt was made to rear it.

The salt-marsh moth (*Leucarctia acræa* Dru.)—The caterpillar was brought to this office July 10, 1897, from Tennallytown, D. C., with the statement that it was feeding on asparagus at that place. September 28 it was found upon asparagus at Marshall Hall, Md.

Unknown measuring worm.—An unknown geometrid was several times taken feeding on asparagus and in different localities, but the species has not been reared beyond the pupa.

A number of other lepidopterous larvæ have been observed on asparagus by various persons, some of which have never been recorded. For convenience they will be considered together, and will only be briefly noticed.

Zebra caterpillar (*Mamestra picta* Harr.).—"Injuriously abundant upon cabbages, asparagus," etc. (Fletcher, Insect Life, Vol. V, p. 125). Also Divisional Note.

Clover Mamestra (*Mamestra trifolii* Rott.).—On asparagus in Europe, but not observed on this plant in America (Taschenberg, Prak. Insectenkunde, Vol. III, p. 124). The European *M. oleracea* and *pisi* also occur on asparagus (l. c.).

Black cutworm (*Agrotis ypsilon* Rott.).—Unpublished Divisional Notes.

Noctua fennica Tausch.—Asparagus beds injured by it in Canada (Fletcher, Insect Life, Vol. III, p. 247).

Red-banded leaf-roller (*Lophoderus triferana* Walk.).—Reared by Miss M. E. Murtfeldt from asparagus in Missouri in 1883. (Divisional Notes.)

PLANT-BUGS AND PLANT-LICE.

Many species of hemipterous insects have been found upon asparagus, but the present list comprises only such as the writer is satisfied actually feed upon this plant.

The tarnished plant-bug (*Pœcilocapsus lineatus* Fab.).—This ubiquitous capsid has been found on asparagus in nearly every locality visited and occurs throughout a season. It is a most difficult species, in the writer's experience, to detect in the act of attacking a plant, but from its numbers on asparagus it is more than probable that it subsists to some extent on this plant.

Lopidea media Say.—May 30, 1897, numerous individuals of this capsid observed at Cabin John, Md., as many as four on a single plant. All the bugs appeared to be sucking up the juice of the asparagus with their beaks. A natural food plant of this species on which it occurred in the immediate vicinity of the asparagus beds where first observed is the common yarrow (*Achillea millefolium*), and the individuals observed on asparagus were very evidently an overflow from the wild food plant.

The leaf footed plant-bug (*Leptoglossus phyllopus* Linn.).—This insect, which breeds normally upon the thistle and sucks the juices of that plant, was received from Nix Bros., Mount Pleasant, S. C., with the statement, made under date of August 28, that it was injurious to asparagus, and a single specimen was found on asparagus in the neighborhood of the District of Columbia. It is quite a general feeder, and has been recorded by Mr. H. G. Hubbard as injurious to the orange.

The thick-thighed Metapodius (*Metapodius femoratus* Fab.).—With the above from Nix Bros., Mount Pleasant, S. C., August 28. This species also affects the orange by sucking the juices from the succulent shoots, flowers, or fruit. (See Hubbard's "Insects Affecting the Orange," p. 162.)

Thyanta custator Fab.—Received with the preceding from Nix Bros., Mount Pleasant, S. C., and *Euschistus servus* Say and *E. crassus* Dall. from the same source, with the statement that they were injurious to asparagus.

The harlequin cabbage-bug (*Murgantia histrionica* Hahn.) has previously been mentioned as attacking asparagus (Bull. No. 7, n. s. Div. Ent., p. 80).

Glassy-winged sharp-shooter (*Homalodisca coagulata* Say).—Received in 1892 from Beaufort, S. C., from a correspondent who had "found them upon his asparagus plants." (Insect Life, Vol. V, p. 152.)

Plum plant-louse (*Myzus mahaleb* Fonsc.).—Observed in its different stages in June at Washington, D. C., and in such numbers as to show conclusively that it feeds upon asparagus.

Melon plant-louse (*Aphis gossypii* Glov.).—Also in its different stages, Washington, D. C.

OTHER INSECTS.

Outside of the orders Coleoptera, Lepidoptera, and Hemiptera asparagus has few foes. In Europe a small two-winged fly, *Platyparea poeciloptera* Schrank, called the asparagus fly, is of considerable economic importance, and the larva of *Bibio hortulans* L. is said to injure the roots. In this country only a single species of Diptera appears to have been associated with asparagus. This is *Bibio albipennis* Say, but it is probably not injurious to this plant (Pract. Ent., Vol. II, p. 83).

Agromyza simplex Loew.—May 10, 1897, and afterwards this minute black fly was observed in abundance on terminal shoots of asparagus, particularly at Cabin John, Md. In two weeks or so no more were to be seen, but June 26 these flies appeared again, usually being found *in copula*. It would appear that this is the first new brood of the year. The abundance of this dipteron on asparagus would seem to indicate that it lives in some manner at the expense of this plant.

Grasshoppers or locusts.—Grasshoppers of several species, particularly of the genus Melanoplus, are often numerous in beds of asparagus, but the only species observed eating this plant was *Melanoplus propinquus* Scudd.

FURTHER NOTES ON THE HOUSE FLY.

By L. O. Howard.

In the article on the house fly in Bulletin No. 4, new series, of this office, the writer suggested the prompt gathering of horse manure and treating it with lime or keeping it in an especially prepared receptacle as a means of abating the fly nuisance. This statement was based upon the knowledge that nearly all of the house flies which bother us in the summer time come from horse stables, and from the idea, not based upon exact experimentation, however, that liming the manure would destroy the contained larvæ. This process is doubtless more or less efficacious in cases of the horn fly, which breeds in cow manure, and only in cow manure which is freshly dropped. A mixture of lime in this case causes such a rapid drying of the manure as to destroy the larvæ. Actual experiments, however, made during the months of August and September, 1897, in Washington show that nothing is to be gained from mixing lime with the horse manure pile as a remedy for house flies.

Experiment 1 (*Air-slaked lime*).—August 5 eight quarts of fresh horse manure, alive with maggots of the house fly, were mixed with two quarts of air-slaked lime. On August 7 no larvæ were dead, and on August 9 very many had hardened into puparia, while the others were seemingly as lively as ever.

Experiment 2 (*land plaster*).—On August 6 eight quarts of horse manure from the same pile were thoroughly mixed with two quarts of gypsum or land plaster. In this case the manure was spread out in a large tin pan and exposed to the sun and air. Three days later examination showed that most of the larvæ had hardened to puparia, while the remainder were in good condition. None were dead, although the manure was found to be very dry.

Experiment 3 (*gas lime*).—August 7 eight quarts of horse manure, alive with larvæ, were thoroughly mixed with two quarts of gas lime and spread out in a large tin pan. August 9 most of the larvæ were found to have hardened into puparia, and none were killed.

The absolute inefficacy of this treatment was somewhat disappointing. Lime was experimented with on account of its cheapness and on account of the ease of application. After consultation with the chemist of the Department it was decided to try experiments with kerosene, since it was considered that an application of kerosene would not injure permanently the fertilizing qualities of the manure, but that it would, perhaps, have the desired effect of retarding fermentation until it should be put into the ground.

Experiment 4 (*kerosene*).—September 4, 8 quarts of fresh horse manure, containing many larvæ of the house fly, were spread out as before in a tin pan. On this was sprayed 1 pint of kerosene. Immediately afterwards 1 quart of water was poured over the manure to

carry the kerosene down into it. September 7, on examination most of the larvæ were found to be dead. About 20 per cent, however, were still alive. The manure was then turned. On September 8 about as many were still living as on the previous day.

Experiment 5 (*kerosene*).—On September 7, 8 quarts of fresh horse manure containing house-fly larvæ were placed as before in a tin pan, sprayed with 1 pint of kerosene, washed down afterwards with 1 quart of water. The manure was then rather thoroughly mixed and a little more water was poured on. The treatment was thus identical with that in experiment 4 with the exception that the manure was stirred after the kerosene spray had been washed in. On September 8 every larva in the mass was dead. The first examination showed not a single survivor.

Experiment 6 (*chlorid of lime*).—October 15, mixed 1 pound of chlorid of lime with 8 quarts well-infested horse manure. Kept in bucket. October 16, nearly 90 per cent of the larvæ were dead, the remainder having burrowed into the large lumps of manure. October 18, no living larvæ could be found.

Experiment 7 (*chlorid of lime*).—October 21, mixed one-fourth pound with 8 quarts rather sparsely infested fresh horse manure. Kept in bucket. October 22, careful examination showed only two dead larvæ. Many were seen which were apparently unaffected. October 23, no dead ones were found. October 25, no dead larvæ found; all larvæ had hardened into apparently healthy puparia.

CONCLUSION AND GENERAL REMARKS.

Experiment No. 5 indicates an easy and cheap method of treating manure piles. Experiment 6, with chlorid of lime, was also successful, but the price of this substance renders it less available for practical use. Most of our chlorid of lime is imported, and the writer is informed by wholesale druggists that the price in this country averages about $10 a barrel. Although it is very generally used here for disinfecting purposes, it is much more extensively used in Europe, where it is much cheaper. In Bulletin No. 4, new series, on household insects, the writer suggested keeping manure in an especially prepared receptacle. He is informed by Mr. Busck that at his home in Denmark, where the house fly had become very abundant and disagreeable on account of a stable nearby, a roofed brick building was built just behind the stable. This had two large swing doors on one side and a smaller door into the stable, through which the manure was always promptly thrown. Each day, after the manure was thrown into this receptacle, a shovelful of chlorid of lime was thrown after it. The manure was eventually hauled away through the double doors. No examination was made to see whether the chlorid of lime actually killed the flies, but it was supposed that it did so; and, at all events, this method of disposing of

the manure resulted in decided relief from house flies in the neighboring house. Where it is possible, then, to build such a receptacle, this course is advised.

All stables should be kept scrupulously clean. The stable of the Department of Agriculture, in which observations had been made, is kept very clean and probably very few flies breed there. It is swept out and washed out frequently. The horse droppings are removed carefully each twenty-four hours and placed in a pile beside the stable, whence, at intervals of a week or more, they are removed to the compost heap some distance away. The daily pile attracts hosts of flies and is soon swarming with larvæ.

In order to ascertain the numbers in which house-fly larvæ occur in horse-manure piles, Mr. Busck, at the request of the writer (and, by the way, Mr. Busck has assisted in all of the experiments), took a quarter of a pound of rather well-infested horse manure on August 9, and counted in it 160 larvæ and 146 puparia. This would make about 1,200 house flies to a pound of manure. This, however, can not be taken as an average, as no larvæ are found in, perhaps, the greater part of the ordinary manure pile. Neither, however, does it show the limit of what can be found, since Mr. Busck counted about 200 pupæ in less than one cubic inch of manure taken from a spot 2 inches below the surface of the pile where the larvæ had congregated in immense numbers.

There are no other horse stables in the immediate vicinity of the Department of Agriculture, and it is reasonable to suppose that the treatment of this temporary pile every third or fourth day by spraying it with kerosene, pouring on water and turning it with a fork, will have an appreciable effect on the number of house flies which, during every summer, annoy the officials of the Department. This treatment should be begun early in the season, since, as with other insects, it is immensely more effective to kill a single individual in the spring than at a later season of the year. This is plainly shown from an estimate which the writer has made, to the effect that from a single overwintering female house fly there may be descended in the course of the following summer a number of individuals mounting into the sextillions. For the person who is curious about statistics of that sort it would be interesting to estimate the length of a line of flies of this number, or the weight of this number of flies, and so on.

It seems to the writer that many persons may consider it worth while to go to the slight trouble needed to treat manure piles in this way and to keep their stables clean. Not only the house fly but the biting stable fly (*Stomoxys calcitrans*) will be killed in this way, and the writer is not at all sure, in view of the possibilities in the way of transmission of disease by both the house fly and the stable fly, that it would not be advisable for city boards of health to pass regulations insisting upon greater cleanliness of stables and such a treatment of manure as has been described.

THE BUFFALO-GNATS, OR BLACK-FLIES, OF THE UNITED STATES.

[A synopsis of the dipterous family Simuliidæ.]

By D. W. Coquillett.

The dipterous family Simuliidæ contains but the single genus Simulium, of which the black-fly of the North and the buffalo-gnat of the South are well-known examples. They outrival the mosquito in their bloodthirsty propensities, poultry and even domestic animals sometimes losing their lives from their attacks.

The black-fly of the North is the *Simulium venustum* Say, of which *S. molestum* Harris and *S. piscicidium* Riley are synonyms. It is not confined to the North, however, but ranges southward as far as Biscayne Bay, Florida, and is found in the other Southern States, extending westward to California. The larvæ of this species were formerly supposed to cause the death of young trout, but this accusation has since been disproved.

The life history and habits of two other species, the Southern buffalo-gnat and the turkey-gnat, have been very thoroughly investigated by this Division, and a full account was published in the annual report of this Department for the year 1886. Neither of these species is confined to the South, both ranging as far northward as New Hampshire and Massachusetts. The food of the larvæ consists chiefly of microscopic Crustacea.

In their relations with man, the most annoying species are *S. venustum*, the black-fly of the north woods, and *S. invenustum*, the buffalo-gnat of the South. There is at least one authentic record of the death of a human being through the attacks of the latter species. Dr. Howard has called attention to the fact that although *S. invenustum* breeds abundantly in Rock Creek, near Washington, D. C., it is not known to bite human beings in this vicinity. Moreover, he informs me that the same species, in May and the early part of June in wet seasons, occurs abundantly in portions of the Catskill Mountains, and that, although it is very annoying by flying about the face and crawling over the skin, it rarely bites. Dr. Howard has also studied the habits of *S. pictipes* at Ithaca, N. Y., and has recorded some observations on the larvæ and egg-laying (the latter having been made by Professor Comstock) of this species in Insect Life, Volume I, pages 99–101. He says that this species also, although its larvæ occur in enormous numbers in the swift-running rock streams about Ithaca, does not, in the adult stage, seem to bite human beings.[1]

[1] The most complete series of observations which has been made upon any species of Simulium, aside from those recorded in the annual report of this Department for 1886, upon the buffalo-gnat of the southwest, was made during 1889–90 by Miss R. O. Phillips, a student in the laboratory of Prof. J. H. Comstock, at Cornell University. The results of Miss Phillips's observations were embodied in her graduating thesis, which has never been published. Professor Comstock has permitted the writer to examine the thesis and to extract the following facts:

The species studied was *Simulium pictipes* Hagen. The adult occurs near Ithaca in

In Osten Sacken's Catalogue of the Diptera, five species are reported as occurring in this country north of Mexico, as follows: *S. decorum* Walk., *S. invenustum* Walk., *S. piscicidium* Riley, *S. venustum* Say and *S. vittatum* Zett.

Since the date of that publication descriptions of five supposed new species have been published, as follows:

Simulium pictipes Hagen, Proc. Boston Soc. Nat. Hist., Vol. XX, p. 305; 1881.
pecuarum Riley, Annual Rept. U. S. Dept. Agric. for 1886, p. 512; 1887.
meridionale Riley, *l. c.*, p. 513.
occidentale Townsend, Psyche for July, 1891, p. 107.
argus Williston, N. Amer. Fauna, p. 253; May, 1893.

The type specimens of the three species described by Professor Riley are now the property of the National Museum. Two of these species are synonyms, viz: *piscicidium* Riley equals *venustum* Say, and *pecuarum* Riley is the same as *invenustum* Walk. *S. occidentale* Towns. is

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the early part of May or at the beginning of the first continuous warm weather in spring. The eggs are deposited on rocks over which the water is flowing. The flies hover in little swarms a foot or two above the rock, flying rapidly back and forth and occasionally darting down and depositing their eggs beneath the water on the flat surface of the rock. The patch of eggs becomes at least a foot or more in diameter, and is distinctly observable at some distance on account of the light yellow color. When the water is very shallow and its velocity slight, the flies sometimes crawl over the surface of the rock and deposit eggs without flying. Only a small proportion of the eggs produce larvæ. The larvæ hatch about eight days after the eggs are laid, and in this stage the insect may be found at any season of the year, through the hottest weather in summer as well as the coldest weather in winter. It is in this stage that it hibernates. Rapid motion of the water is essential to the life of the larvæ, which die within three or four hours if placed in quiet water. Fastened to the rock by the anal end of the body, they assume an erect position and move the head around occasionally with a circling motion.

They may release themselves, and as they grow larger they sometimes allow themselves to be washed into deeper water, holding by a thread which they spin as they go. The thread is spun from the mouth, but is attached along the side of the body to the different segments. Sometimes a large cluster of larvæ will cling to the same thread, which they can ascend in much the same manner as do spiders. In the winter the larval fans are usually kept closed, and not much food is taken. During the summer the length of the larval life is about four weeks, varying somewhat with the temperature and the velocity of the water. At full growth the larva spins its cocoon, firmly attaching it to the rock and also to adjacent cocoons. The length of the pupal stage is about three weeks. Over-wintering larvæ transform to pupæ about the 12th of April, the first flies appearing on the 2d of May. The newly bred fly, surrounded by a bubble of air, quickly rises to the surface of the water and flies away instantly. The first brood having appeared in early May, successive generations are produced from this time on during the summer and part of the autumn. All of the flies captured from the first brood were females, but toward autumn the males began to appear in greater numbers, and toward the last of August nearly all the specimens taken were males. [On September 2, 1888, the present writer captured fifty specimens of this fly at Ithaca, and all were males with the exception of one.] Adults were observed on the wing as late as the 10th of October. Many points not here touched upon were brought out in the thesis, which should be published in full.—L. O. H.

evidently a synonym of *meridionale* Riley; *decorum* Walk. of *vittatum* Zett.; and *molestum* Harris equals *venustum* Say.

In several species the color of the femora varies from yellow with brown tips to wholly brown. The knob of the halteres is always yellow. In the female the abdomen consists of eight segments, but there is an additional one in the male. Illustrations of the female of *invenustum*, and of the male of *meridionale* are reproduced in figures 16 and 17.

FIG. 16.—*Simulium invenustum:* female fly, enlarged (after Riley; Rept. Dept. Agr. 1886).

With the exception of *argus* Williston, which is unknown to the writer, the following table contains all the species known to occur in the United States, all of which are represented by both sexes in the National Museum collection.

TABLE OF THE SPECIES OF SIMULIUM.

1. Thorax largely or wholly blackish 2
   Thorax and entire insect yellow, the head, abdomen, and tarsi sometimes blackish; length, 3mm. Custer Co., Colo., and Bear Paw Mts., Mont. *ochraceum* Walk.
2. Hind tarsi distinctly bicolorous, yellowish and blackish 4
   Hind and other tarsi and all legs unicolorous, yellow, brown, or black 3
3. Abdomen of female gray, marked with a velvet-black fascia on segments 3 and 4, and sometimes with two subdorsal spots of the same color on 2, 5, and 6; thorax bluish gray, with three black vittæ; mesonotum of male velvet black, unmarked; the dorsum of abdomen of the same color, marked with a gray spot on sides of segments 3, 6, 7, and 8; length, 1.5 to 2mm. Boston, Mass.; Agricultural College, Mississippi; Texas and Nebraska ..... *meridionale* Riley.
   Abdomen of female grayish brown or black, the sides marked with a row of velvet-black spots; mesonotum grayish brown, marked with three darker vittæ; mesonotum and abdomen of male grayish brown, unmarked; length, 2 to 5mm. White Mountains, New Hampshire; Catskill Mountains, New York (May); Adirondack Mountains, New York (May); Wilmuth, N. Y.; Cambridge, Mass.; Roxbury, Conn.; District of Columbia; Grand Ledge, Mich.; Lakeview, Miss., and Louisiana.. *invenustum* Walk.

FIG. 17.—*Simulium meridionale:* male fly, enlarged (after Riley; Rept. Dept. Agr., 1886).

4. Eyes widely separated (females) 5
   Eyes contiguous (males) 9
5. Sixth, and usually the two succeeding segments of abdomen opaque, the sixth marked with velvet black 6
   Sixth and two succeeding segments of abdomen subshining brown and destitute of velvet-black markings, segments 3, 4, and 5 opaque velvet black; mesonotum grayish black, not vittate, the sides and front corners light gray; bases of tibiæ usually, of first joint of the middle and hind tarsi, and sometimes bases of femora, yellow; front side of front tibiæ metallic silvery; length, 1.8 to 3mm. Beaver Mine, Canada; Franconia and White Mountains, New Hampshire; Lake Placid, New York; Huron Mountains, Michigan; Minnesota; National Park, Wyoming; Glenora, British Columbia; Wilsons Peak, Cal.; Texas; Louisiana; Lakeview, Miss., and Biscayne Bay, Fla.... *venustum* Say.

6. Dorsum of abdomen distinctly marked with gray, nearly bare 7
Dorsum of abdomen deep black, not marked with gray, quite densely clothed with nearly erect yellowish tomentum, mesonotum also deep black and wholly covered with appressed golden yellow tomentum; pleura grayish black; legs nearly bare, yellow, apices of femora and of tibiæ, and whole of tarsi except the basal five-sixths of the first joint of the hind ones, brown; first joint of front tarsi scarcely dilated, the first joint of the hind ones one-half as wide as their tibiæ; head gray, covered with a pale yellow tomentum; antennæ black, the two basal joints yellow, mouthparts black; wings hyaline, costal, first three veins and first section of the fourth, yellow, the remainder subhyaline; length, 1.5mm. Cambridge, Mass. (May 31, 1889), and Los Angeles County, Cal. Two females, the one from California captured by the writer .. *bracteatum* n. sp.
7. Fifth segment of abdomen marked with three velvet-black spots, which are sometimes connected by a narrow black line at the extreme base of the segment .. 8
Fifth segment, and also the third and fourth, marked with a broad velvet-black fascia, front corners of the sixth and usually of the seventh segment also velvet black, the middle of these segments brown; mesonotum gray, marked with three black vittæ, a black dot in front of the insertion of each wing; base of first joint of hind, and sometimes of the middle tarsi, yellow, bases of femora and tibiæ sometimes also yellow; length, 2.5 to 4mm. Ithaca, N. Y.; Shovel Mountain, Texas, and Wilsons Peak, California ..... *pictipes* Hagen.
8. Front and other femora brown, their bases sometimes yellow; mesonotum gray, marked with five black vittæ; abdomen gray, bases of segments three to seven or eight each marked with a velvet-black fascia produced backward in the middle and at the ends; length, 2 to 4mm. Niagara Falls, N. Y.; Grand Rapids, Minn.; Glencoe, Nebr.; Onaga, Kans., and Wilsons Peak, Cal.. *vittatum* Zett.
Front and middle femora and tibiæ wholly yellow, hind ones except their apices also yellow, tarsi brown, bases of the first two joints of the middle and hind ones yellow; mesonotum grayish, indications of a darker median vitta, the sides and front corners yellow, pleura light gray, scutellum yellow; abdomen gray, segments two to six each marked with three velvet-black spots; wings hyaline, the costa, first three veins, and first section of the fourth, yellow, the others subhyaline; face and front light gray, antennæ brown, the two basal joints yellow, palpi black, proboscis yellowish; length, 1.5mm. Colorado. Three females, collected by Mr. Carl F. Baker ..... *griseum* n. sp.
9. Mesonotum gray at least on the sides and hind margin 10
Mesonotum wholly velvet black; abdomen with a gray spot on the sides of the second, fifth, sixth, and seventh segments, legs almost wholly brown, otherwise as in the female. Two male specimens taken with the female (see above under 6) ..... *bracteatum* n. sp.
10. Center of mesonotum largely or wholly velvet black 11
Center of mesonotum with a narrow, black vitta, mesonotum elsewhere gray, dorsum of abdomen velvet black, the second and seventh segments and a spot on the sides of the eighth, silvery gray, otherwise as in the female. A male specimen taken with the females (see above under 8) ..... *griseum* n. sp.
11. Sides of abdominal segments four to seven, destitute of dense clusters of silvery white hairs; mesonotum with a gray streak extending obliquely inward from each humerus 12
Sides of these segments with silvery white hairs, mesonotum destitute of a gray streak extending inward from the humeri (see above under 8) .. *vittatum* Zett.
12. Suprahumeral gray stripes metallic, no metallic spots between them; mesonotum not vittate with black (see above under 5) ..... *venustum* Say.
Suprahumeral gray stripes not metallic, two metallic spots between them, mesonotum usually with three black vittæ (see above under 7) .... *pictipes* Hagen.

ON THE HABITS OF THE OSCINIDÆ AND AGROMYZIDÆ, REARED AT THE UNITED STATES DEPARTMENT OF AGRICULTURE.

By D. W. Coquillett.

So little is at present known regarding the early stages of the Diptera of this country that any contribution to this subject must prove of interest, not only to students of natural history, but also to persons engaged in agriculture, whose growing crops are sometimes severely injured through the depredations of these insects.

FAMILY OSCINIDÆ.

Although the family Oscinidæ is of small extent, its members differ quite widely in regard to their food habits, some attacking growing plants not previously injured by other insects, some living in burrows or cavities in plants made by other insects, while a few feed upon the egg-shells and cast-off skins of insects. In the department insectary a large number of these insects have been reared, and by authorization of Dr. Howard, the entomologist, the records of these rearings are now for the first time made public.

Genus Meromyza Meig.

The larvæ of this genus attack plants of wheat and rye not previously injured by other insects; at least two, and probably three, broods are produced in one season, the last one passing the winter in some of its earlier stages.

Meromyza americana Fitch.—Infested wheat plants were received June 19, 1884, from F. M. Webster, Oxford, Ind., and the adult flies issued on the 8th of the following month.

From a second lot of wheat plants, comprising the heads and portions of the stems above the uppermost node, received June 2, 1886, from J. G. Barlow, Cadet, Mo., the flies issued on the 18th of the same month. The insects were in the larva state when received.

In the autumn of 1888 a number of young wheat plants were received from F. M. Webster, who collected them at New Harmony, Ind., and the adult flies issued May 14, 1889.

A bundle of rye straws containing the larvæ of this insect was received July 6, 1896, from H. A. Muller, Mullers Lake, Wis., and the adults issued on the 18th of the same month.

Genus Chlorops Meig.

The larvæ of this genus likewise attack plants not previously injured by other insects.

Chlorops proxima Say.—A number of wheat plants were received May 1, 1880, from E. Schneider, Fairview, Ky., and an examination revealed the presence of several puparia of this insect, situated between the sheaths of the leaves and the stalk; the adult flies issued on the 10th of the same month.

An adult was bred October 24, 1887, by A. Koebele, from a gall-like swelling on the stem of *Elymus arenarius* collected a few days previously near Alameda, Cal.

Chlorops ingrata Will.—On August 12, 1884, several plants of *Muhlenbergia mexicana* were received from F. M. Webster, Oxford, Ind. At the tips of the plants were gall-like swellings, each containing a larva or puparium of this insect. The adult flies issued May 12, 15, and 21, and June 1, of the following year.

Chlorops graminea Coq.—An adult of this species was bred by A. Koebele, June 12, 1888, from a gall-like swelling on an unknown grass collected in April of that year at Lancaster, Cal.

Chlorops assimilis Macq.—On July 26, 1884, Mr. Theo. Pergande found two larvæ and one puparium of this insect among a colony of aphides on the roots of *Poa pratensis*. One of the flies issued on the 31st of the same month.

On September 6, 1892, several sugar beets were received from the W. B. Sugar Company, of Castroville, Cal., and in the leaves were found a number of the puparia of this insect. The adult flies issued two days later.

Larvæ and puparia of this species were taken September 1, 1897, by Messrs. F. H. Chittenden and F. C. Pratt in the earth about the roots of horse-radish in the vicinity of Tennallytown, D. C. Several adults issued a few days later. The larvæ and puparia were evidently attacked by one or more species of minute Staphylinidæ found with them in all stages, and some of the puparia gave forth the proctotrypid parasite *Loxotropa californica* Ashm.

Genus Gaurax Loew.

The two preceding genera belong to the group Chloropinæ, while the present genus and the genera which follow belong to the Oscininæ. The larvæ of the genus Gaurax differ in a marked degree in habits from the others in that they feed upon insect remains instead of vegetable matter.

Gaurax anchora Loew.—A cluster of egg shells of *Corydalus cornutus* found August 24, 1895, by Mr. E. A. Schwarz, near Washington, D. C., was placed in a glass vial containing damp sand, and on the 3d of the following month a puparium of this Gaurax was found in the sand; the adult fly issued on the 12th of the same month.

Four adults issued April 9, 1896, from cocoons of *Orgyia leucostigma* collected in September of the preceding year; the larvæ were observed to feed upon the cast-off skins of the caterpillars and upon the chrysalis shells. Another adult issued April 17, and one on the 18th, from the same lot of cocoons. Other adults were bred in May, July, August, and September, 1896, from larvæ found in the cocoons of the above moth.

Gaurax aranea Coq.—Adults were bred March 2 and 9, 1886, from an egg sac of *Argiope riparia* Hentz. Others were received from Dr. A. Davidson, Los Angeles, Cal., who reported having bred them from larvæ found among spiders' eggs.

Genus Elachiptera Macq.

The rearings indicate that the larvæ of this genus usually attack plants not previously injured by other insects, but a few evidently live in the deserted burrows of other insects; and while the greater number evidently feed upon living vegetable matter, a few were found in situations which indicated that they prefer decayed to living vegetable matter.

Elachiptera longulā Loew.—On August 14, 1884, several plants of *Panicum crusgalli* were received from F. M. Webster, Oxford, Ind.; the upper parts of these plants were infested with the larvæ of this insect, the adults of which issued on the 22d and 30th of the same month.

Two adults issued July 15, 1886, from plants of oats received on the 2d of the same month. Others were received from W. B. Alwood, Columbus, Ohio, who reported having bred them from oats.

From a number of plants of fall wheat received July 10, 1890, from F. M. Webster, Lafayette, Ind., two adult flies issued the next day.

Elachiptera nigricornis Loew.—Adults of this species were also bred from the fall wheat plants referred to in the preceding paragraph.

Elachiptera costata Loew.—This species was also bred from the above-mentioned plants of fall wheat.

Three adults issued July 15, 1886, from plants of oats received on the 2d of the same month. One specimen was received July 9, 1886, from W. B. Alwood, Columbus, Ohio, who also bred it from oats.

Two adults were bred by the writer in McHenry County, Ill., from larvæ found in a decayed cavity in the roots of a living garden radish.

On August 29, 1894, a melon root was received from M. P. Barnard, Kenneth Square, Pa.; the root was decayed in several places, and in the cavities were larvæ of this insect. The adults issued September 14 and October 10 of the same year.

Elachiptera nigriceps Loew.—Issued August 15, 1883, from pond-lily plants infested with the larvæ of *Pyrausta penitalis* which had burrowed into the stems and seed pods. The plants were collected at Washington, D. C., August 1.

On August 24, 1883, Mr. A. Koebele found several larvæ of this insect at Washington, D. C., in a gall-like fungus growth on the stem of a water lily; three adults issued on the 12th of the following month.

Adults were also reared August 25, 1886, from decaying water lily plants collected by Theo. Pergande at Washington, D. C.

From plants of *Panicum crusgalli* received August 14, 1884, from F. M. Webster, Oxford, Ind., several adults issued on the 11th of the following month.

Specimens were reared July 15, 1886, from oat plants received on the 2d of the same month from the same observer.

Elachiptera flavida Will.—An adult issued June 27, 1891, from a stalk of sugar cane received on the 15th of this month from D. C. Sutton, Runnymede, Fla.; the stalk was also infested with a caterpillar of *Diatræa saccharalis*.

Genus Hippelates Loew.

Only a single species of this genus has been reared, the larva evidently living in the deserted burrow of another insect. The adults of several species are sometimes very annoying by their persistent efforts to get into the eyes of both man and animals.

Hippelates convexus Loew.—An adult issued June 27, 1891, from a stem of sugar cane received on the 15th of the month from D. C. Sutton, Runnymede, Fla.; the stalk was also infested with the larva of *Diatræa saccharalis*.

Genus Oscinis Latr.

The larvæ of this genus usually attack living plants not previously injured by insects, but a few species live in the deserted burrows of other insects.

Oscinis trigramma Loew.—Issued October 4 and 28, 1881, from puparia found in burrows of *Elasmopalpus lignosellus* Zell., in stalks of corn September 29, by Prof. W. S. Barnard, at Atlanta, Ga.

An adult was bred July 11, 1890, from plants of fall wheat received the preceding day from F. M. Webster, Lafayette, Ind.

Two issued May 21, 1891, from strawberry roots received on the 1st of the month from H. T. Back, Coeur d'Alene, Idaho; the roots were also infested with a Chrysobothris larva.

An adult was bred by A. Koebele from a stem of an unknown grass collected in the Santa Cruz Mountains, California; the stem was also infested with a larva of a species of Cephus.

Oscinis coxendix Fitch.—Issued October 28, 1881, from a puparia found in a burrow of *Elasmopalpus lignosellus* Zell., in a stalk of corn collected September 29, by Prof. W. S. Barnard, at Atlanta, Ga.

Several adults issued July 6, 1886, from young corn plants obtained on the 18th of the preceding month by Theo. Pergande at Mount Vernon, Va.; the plants were also infested by the larvæ of *Diabrotica 12-punctata*. Others were bred from corn plants September 12, 1891.

One specimen issued July 31, 1886, from a plant of *Poa pratensis* collected on the 1st of the month by Theo. Pergande in Washington, D. C.

An adult issued July 11, 1890, from a plant of fall wheat received the previous day from F. M. Webster, Lafayette, Ind.

Oscinis soror Macq.—Adults were bred September 11, 1884, from several plants of *Panicum crusgalli* received on the 14th of the preceding month from F. M. Webster, Oxford, Ind.

One specimen issued May 15, 1885, from seed pods of *Vernonia noveboracensis* collected October 22, 1884, by Theo. Pergande in Washington, D. C.; the pods were also infested by the caterpillars of *Platynota sentana* and *Eudemis botrana*.

Adults were received June 25 and July 9, 1886, from W. B. Alwood, Columbus, Ohio, who bred them from oat plants.

Bred June 24, 1886, from stems of *Poa pratensis*.

An adult issued June 21, 1887, from a stem of *Poa pratensis* received on the 1st of the month from F. M. Webster, Lafayette, Ind.

From a number of plants of fall wheat received from the same source, July 10, 1890, the adults issued a few days later.

Roots of cucumber containing larvæ of this insect were received September 22, 1896, from W. C. Appleby, Carroll, Md., and an adult issued on the 2d of the following month.

Adults were received from G. C. Davis, Agricultural College, Mich., September 19, 1896, who stated that he bred them from strawberry plants.

Oscinis carbonaria Loew.—From a stalk of wheat received June 25, 1883, from J. G. Kingsbury, Indianapolis, Ind., an adult issued on the 18th of the following month; the larvæ infested the stem at the uppermost node, and pupated within the stem. Their attacks resulted in killing the head of wheat.

From several young wheat plants received September 8, 1884, from F. M. Webster, Oxford, Ind., the adult flies issued on the 10th, 11th, 13th, and 16th of the same month; the larvæ infested the lower portion of the plants.

Adults issued July 7, 1885, from puparia in wheat plants received on the 3d of the month from L. Bruner, West Point, Nebr.

Others were received August 30, 1886, and August 9, 1888, from F. M. Webster, Lafayette, Ind., who also bred them from wheat plants.

From plants of fall wheat received from the same source, July 10, 1890, the adult flies issued in the course of a few days.

Two puparia of this insect in the base of a stem of *Agropedium caninum* were received May 25, 1889, from James Fletcher, Ottawa, Canada, and the adults emerged on the 30th of the same month.

Oscinis umbrosa Loew.—Two adults issued July 22, 1886, from plants of *Poa pratensis* collected by Theo. Pergande at Washington, D. C., on the 1st of the month; the larvæ lived in the middle of the stems close to the ground, and were found in young plants less than three inches high.

From plants of fall wheat received July 10, 1890, from F. M. Webster, Lafayette, Ind., the adults issued a few days later.

Oscinis pallipes Loew.—An adult was received from W. H. Ashmead, Jacksonville, Fla., who reported having bred it from a plant of artichoke.

Oscinis longipes Loew.—From seed pods of *Catalpa speciosa* received November 19, 1877, from Thos. Meehan, Germantown, Pa., adults

issued from February 18 to April 27, 1878. The larvæ infested the seeds as well as the pods, and as many as eight larvæ sometimes occurred in a single cavity. Another lot of infested seed pods was received January 25, 1879, from J. A. Warder, North Bend, Ohio, and the adults issued February 18 and 20 and March 17 of the same year.

Genus Siphonella Macq.

Our breeding records indicate that while the larvæ of one species live in the deserted burrows of other insects, those of a second species feed upon the egg shells of spiders, thus combining in their habits those of the genus Gaurax with those of the other genera of this family.

Siphonella inquilina Coq.—From a cecidomyiid gall on an undetermined species of Aster collected October 10, 1874, by O. Lugger, at St. Louis, Mo., an adult of this species issued February 15 of the following year. The gall when first found did not contain any cecidomyiian, and the Siphonella had evidently lived as an inquiline after the original occupants had abandoned the gall.

From a puparium found in a cavity in an apple an adult issued May 28, 1881; the cavity was doubtless made by a caterpillar of *Carpocapsa pomonella*.

On June 20, 21, and 23, 1884, adults of this insect issued from twigs of *Cephalanthus occidentalis* collected on the 17th of the month by A. Koebele in Virginia; the twigs were also infested by caterpillars of *Laverna cephalanthiella* Chamb.

An adult was received from Miss M. E. Murtfeldt, Kirkwood, Mo., who stated that she reared it February 11, 1891, from a berry of *Solanum carolinense*.

Siphonella oscinina Fall.—Four adults issued August 25, 1895, from an egg sac of a spider found on the 17th of the month by Theo. Pergande, at Riverview, Md.

FAMILY AGROMYZIDÆ.

Dr. H. Loew, who has written more extensively concerning the systematic arrangement of the Diptera of this country than any other author, erected a distinct family for the genus Phytomyza, but its members are altogether too closely related, structurally and also in regard to their food habits, to the genus Agromyza to be placed in a different family, and I have therefore followed Dr. Schiner in uniting the so-called family Phytomyzidæ with the Agromyzidæ. Representatives of four of the genera have been bred at the insectary of this Department. These genera also occur in Europe, where they are reported as having the same habits as in this country. The larvæ of one genus, Leucopis, prey upon plant lice and scale insects, while those of the other three genera, Ceratomyza (formerly known as Odontocera, a preoccupied name), Agromyza, and Phytomyza, feed on living plants by forming burrows or mines in various parts of them, but principally in the leaves.

Having recently made a careful study of the specimens belonging to this family contained in the National Museum collection, which includes those bred at the insectary of this Department and by the writer, the records of these rearings are brought together in the present paper, and in addition such data as have been communicated by correspondents who have transmitted bred specimens for names.

Leucopis nigricornis Egger.—This species was evidently introduced from Europe, although at the present time it occurs all over this country, ranging from New Hampshire to Florida and westward to California. A specimen from France agrees in all points with others from this country. The larvæ prey upon various kinds of plant lice by capturing them and sucking out their juices. When fully grown they seldom wander far from their feeding grounds, but attach themselves by a viscid substance and soon contract into puparia, after the manner of many kinds of syrphus flies.

Bred February 28, 1879, by Mr. E. A. Schwarz, from larvæ found in the galls of *Pemphigus transversus* at Columbus, Tex.

Bred by the writer July 6 to 9, 1883, at Sacramento, Cal., from larvæ feeding upon aphidids on thistles; the larvæ pupated from June 26 to 28. Also reared at Los Angeles, Cal., May 21, 1887, from larvæ preying upon aphidids on willows.

Issued July 18, 1883, from larvæ feeding upon aphidids on a cherry tree at Boscowen, N. H. Also issued July 8, 1888, from larvæ feeding upon the same kind of aphidids.

Issued March 14, 1884, from larvæ in galls of *Pemphigus bursarius* received March 11 from J. Lichtenstein, Montpellier, France.

Issued July 12 and 13, 1889, from larvæ preying upon *Siphonophora avenæ* on wheat collected June 26 by F. M. Webster, at Vincennes, Ind.

Leucopis simplex Loew.—Issued August 9, 13, and 16, 1883, from larvæ in galls of *Phylloxera vitifoliæ* collected July 30 by Mr. T. Pergande, in Virginia. Also August 11, 1891, from galls of the same insect received from C. A. Davis, Alma, Mich. Also bred in July, 1890, from galls of this insect by T. A. Williams, Fremont, Nebr.

Issued May 14, 1897, from larvæ preying upon *Chermes pinicorticis*, collected May 11 by Mr. T. Pergande, at Washington, D. C.

Leucopis bella Loew.—Issued in May, 1889, from larvæ preying upon a species of Eriopeltis on swamp grass in Nova Scotia, received from Dr. James Fletcher, Ottawa, Canada.

Issued February 23 and March 1, 1892, from larvæ preying upon a species of coccus on Opuntia sp. collected by Mr. C. R. Orcutt, San Diego, Cal. Also May 11, 1896, from larvæ preying on this Coccid received January 27 from C. H. T. Townsend, who collected them at San Antonio, Tex. And November 5, 1896, from larvæ preying upon the above-mentioned Coccid, received September 21 from S. A Pease, San Bernardino, Cal.

Reared by the writer June 17, 1887, from larvæ preying on a species

of Rhizococcus on *Artemisia californica*, collected May 29 at Los Angeles, Cal.

Three specimens issued September 14, 1894, from larvæ feeding upon a species of Pulvinaria on *Sullengia sylvatica* received August 17 from E. A. Schwarz, who collected them at Rockport, Tex.

Leucopis bellula Will.—Issued October 15, 1886, from larvæ preying upon *Coccus cacti* collected in Texas by Dr. H. W. Wiley, chemist of this Department.

Issued January 2, 6, and 29, 1897, from larvæ preying on *Coccus confusus* received October 16, 1896, from C. H. T. Townsend, Mesilla, N. Mex.

Issued November 3, 7, and 13, 1894, from larvæ preying upon a species of Acanthococcus received October 29 from C. H. T. Townsend, who collected the specimens at Dalles, Mexico.

Reared by Mr. T. D. A. Cockerell, Mesilla, N. Mex., from larvæ preying upon *Orthezia nigrocincta*.

Ceratomyza dorsalis Loew.—Issued October 12, 1888, from a puparium found in a mine in a leaf of timothy received September 3 from F. M. Webster, Lafayette, Ind. Adults were previously bred from the same plant by Mr. Webster. Also bred in 1888 by the same person from larvæ mining the leaf-sheathes of young wheat plants.

Agromyza melampyga Loew.—From mines in leaves of a cultivated species of Philadelphus collected in Washington, D. C., during the latter part of July, 1884, six adults issued on the 12th of the following month. From mines in leaves of *Plantago major* collected June 28, 1888, at Washington, D. C., the adults issued July 5, 7, 9 and 10; the larvæ pupate within the mines. Another adult issued June 27, 1896, from a mine in a leaf of the above-mentioned plant from the same locality.

Agromyza jucunda v. d. W.—(An examination of the type specimen of *Oscinis malvæ* Burgess, described in the Annual Report of this Department for 1879, page 202, reveals the fact that it is not distinct from the above-mentioned species of Agromyza.)

Issued July 20, 1874, from larvæ found at St. Louis, Mo., June 30, in mines in the leaves of the cultivated verbena. Also October 1, 3, 26, 29, and 31, 1881, from larvæ mining the leaves of the above-mentioned plant at Washington, D. C., collected by Dr. Riley September 28.

Four flies issued November 14, 1879, from larvæ mining the leaves of *Malva rotundifolia* collected October 23 at Washington, D. C., by Mr. T. Pergande.

Issued September 9 and 16, 1885, from larvæ mining the leaves of the cultivated sunflower.

Reared by the writer June 5, 6, and 11, 1887, at Los Angeles, Cal., from larvæ forming large mines in the leaves of *Xanthium strumarium*, *Aplopappus squarrosa*, *Helianthus annuus*, and *Solidago californica*. The mines are irregular in outline, from 10 to 15^{mm} in diameter, at first whitish, but finally turning almost black. The larva forms a

cup-shaped swelling on the under side of the leaf, and in the center of this the change to the pupa and finally to the adult state takes place.

Issued July 7, 9, and 15, 1896, from larvæ mining the leaves of *Aster ericoides* in the District of Columbia, collected July 5 by Mr. T. Pergande.

Agromyza diminuta Walk.—(An examination of the types of *Oscinis trifolii* Burgess described in the Annual Report of this Department for 1879, page 201, and of *Oscinis brassicæ* Riley, described in the Annual Report for 1884, page 322, proves that both descriptions refer to the same species, which was previously described by Walker as *Phytomyza diminuta*. It is, however, a true species of Agromyza.)

Issued June 19, 1876, from larvæ mining the leaves of the potato, collected June 3 at Foristell, Mo.

Issued June 29, 30, and July 2, 1879, from larvæ mining the leaves of white clover at Washington, D. C., collected June 18 by Mr. T. Pergande.

Reared by the writer from larvæ found in large mines in the leaves of cabbage in September, 1887, at Los Angeles, Cal. Also bred from a stem of cabbage by H. Osborn, Ames, Iowa.

Agromyza æneiventris Fall.—Reared in 1886 by F. M. Webster from larvæ found in burrows in roots of clover; also bred by T. Pergande March 4 and 19, 1895, from larvæ found in burrows in stems of Ambrosia.

Agromyza neptis Loew.—Issued August 25 and 28, 1883, from larvæ mining the leaves of Indian corn at Washington, D. C.; collected August 9 by Mr. T. Pergande, whose account of this insect is substantially as follows: The eggs are deposited on the under side of the leaves and soon produce an oval colorless spot. As soon as hatched the young larva burrows into the leaf, and then turns and runs its mine just beneath the upper epidermis. At first the mine is not visible from the under side of the leaf, but as the larva increases in size it enlarges the mine until it is visible on both sides of the leaf. The mine sometimes attains a length of 6 inches, and is about one-eighth of an inch wide.

Issued July 20, 1884, from larvæ mining the leaves of solidago, collected by Mr. T. Pergande June 25 in Virginia.

Agromyza setosa Loew.—Issued August 8, 1891, from larvæ mining the leaves of *Zizania aquatica*, collected by T. Pergande in the District of Columbia.

Reared in 1896 by Mr. F. A. Sirrine, Jamaica, N. Y., from larvæ mining the leaves of the garden chrysanthemum.

Reared in November by A. Koebele, from larvæ mining the leaves of the strawberry in Placer County, Cal.

Phytomyza aquilegiæ Hardy.—Eight adults issued during the latter part of October, 1884, from larvæ mining the leaves of the garden nasturtium, collected early in September at Washington, D. C. Others

were bred by the writer in July, 1897, from larvæ found in narrow, tortuous mines in the leaves of the above-mentioned plant.

Reared in 1894 by Mr. W. E. Button, New Haven, Conn., from larvæ mining the leaves of the columbine.

Phytomyza chrysanthemi Kowarz.—Issued December 30 and 31, 1886, and January 5, 6, 7, and 10, 1887, from larvæ mining the leaves of the cultivated chrysanthemum, received December 30, from Charles Henderson, of New York; the larvæ pupate within their mines.

Issued March 5, 1890, from larvæ mining the leaves of the Marguerite daisy, received February 28, from James Read, Irvington, N. Y. Also March 31 and April 2 and 3, 1890, from larvæ mining the leaves of the above-mentioned plant, received March 27, from J. H. Ives, Danbury, Conn.; and April 5, 7, 8, 10, and 14, 1890, from leaves of the feverfew, received April 3, from the same person.

Phytomyza obscurella Fall.—Reared by the writer May 8, 1887, from larvæ found April 19, in long, tortuous mines in the leaves of *Lupinus albicaulus* at Los Angeles, Cal.

THE TOBACCO FLEA-BEETLE.

(*Epitrix parvula* Fab.)

By F. H. Chittenden.

LARVAL HABITS OF THE GENUS.

Until within a year the larval habits of our flea-beetles of the genus Epitrix were unknown, a very general impression prevailing that the larvæ were leaf-miners. Writers on economic entomology have fostered this belief, and very recently one has made the positive statement that the larva of the common cucumber flea-beetle (*Epitrix cucumeris* Harr.) "is a miner, feeding within the substance of the leaves of the infested plants." It remained for Messrs. F. C. Stewart and F. A. Sirrine to discover the true larval habit of the genus, namely, that it is subterranean, a hypothesis that had previously been entertained by Mr. E. A. Schwarz and the writer from the fact that the larvæ were not to be found in the leaves or stems. On this head Mr. Schwarz wrote of *cucumeris* (Proc. Ent. Soc. Wash., Vol. II, p. 184): "Its true food plant will, no doubt, prove to be one of the Solanaceæ, and the larva is probably a root-feeder." Messrs. Stewart and Sirrine found the larva of this species boring into the tubers, roots, and rootstalks of potato, this work resulting in the formation of "slivers" or "pimples" as has been narrated in Bulletin 113 of the New York Agricultural Experiment Station and the Proceedings of the Iowa Academy of Sciences for 1896 (pp. 170–172). Potatoes so affected sold for as much as 5 cents a bushel lower than the regular market price.

RECENT OBSERVATIONS.

August 18, 1897, in company with Mr. F. C. Pratt, the writer found numerous pupæ of Epitrix at the roots of Jamestown weed (*Datura stramonium*) and the common nightshade (*Solanum nigrum*) and a few larvæ of at least two species. The pupæ could not be positively identified at the time, and as both larvæ and pupæ are exceedingly delicate only a portion of the material obtained was reared. The pupæ were most numerous within a very short distance of the surface of the earth, but were found to the depth of an inch, and, in one or two cases two or three inches, from the bases of the stems of the host plant, one individual being found at a distance of about four inches, under a stone, showing that under favoring conditions the larvæ travel under, or more probably over, the earth, and when this is moist with dew. Three species of Epitrix (*cucumeris*, *fuscula*, and *parvula*) were found on these plants; hence it was impossible to identify all the immature stages. Such pupæ as developed, however, proved to be *parvula*. One bred August 23 remained at least five days in the pupal condition. Subsequently other larvæ and pupæ were found, but none during the first week of September, and it would seem probable that the last generation of the year develops in this latitude toward the end of August. Beetles were found on eggplant early in October, but in decreased numbers, and it is not impossible that there may be a later generation; but this is not probable.

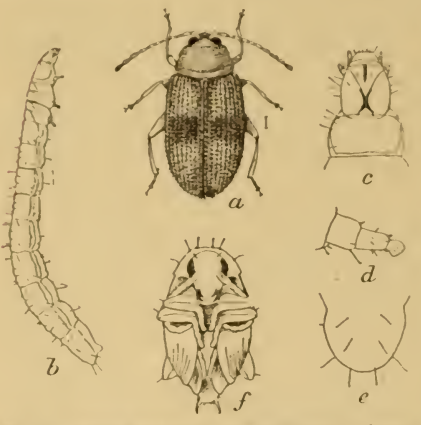

FIG. 18.—*Epitrix parvula*: *a*, adult beetle; *b*, larva, lateral view; *c*, head of larva; *d*, posterior leg of same; *e*, anal segment, dorsal view; *f*, pupa; *a*, *b*, *f*, enlarged about fifteen times; *c*, *d*, *e*, more enlarged (original).

BEETLE, LARVA, AND PUPA BRIEFLY DESCRIBED.

The adult beetle is very minute, measuring scarcely above one-twentieth of an inch (1.5^{mm}) in length, oblong ovate in form, and light brown in color. The elytra are usually marked with a dark transverse median band of greater or less extent. (See fig. 18, *a*.)

The egg of this species, or of the genus, for that matter, appears never to have been observed.

The larva is illustrated at *b*. In a general way it resembles Diabrotica, having the same number of segments, joints of legs, antennæ, and palpi. It is, of course, more minute, measuring only a trifle above an eighth of an inch in length (3.5^{mm}) when fully grown. It is delicate and filiform or thread-like, milk white in color, except the head, which is honey yellow with darker brown mouth-parts and sutures. (See *c*.)

The body is subcylindrical, moderately wrinkled and segmented, and sparsely covered with short hairs. The head is only moderately chitinous, and the first thoracic and last or anal segment are apparently not at all, or at least only slightly, chitinized. The anal segment, shown, dorsal view, at *e*, is furnished with a small proleg, but there are no visible denticles at its apex. The leg is best recognized by reference to figure 18, *d*.

The pupa is white, like the larva, and also resembles somewhat that of Diabrotica, especially in the anal hook-like appendages. (See *f*.)

PUBLISHED OBSERVATIONS ON HABITS AND INJURIES.

References to the habits of *Epitrix parvula* are somewhat limited, considering its distribution and abundance, which may be accounted for from the fact of its being a southern species. It occurs in the north, but its injuries appear to be confined to the more southern States.

In the third volume of the American Entomologist (p. 123), published in 1880, this insect is mentioned under the name of *Epitrix hirtipennis* Melsh. as doing "considerable damage to tobacco plants on the Bahama Islands by completely riddling the leaves, and thus rendering them unfit for use." In the same article attention is drawn to serious complaints of the "flea-bug," by which we may recognize this species, in the tobacco-growing sections of Kentucky. In many parts of that State young tobacco plants were "literally cleaned off," and farmers were burning and sowing new beds. A decade later Mr. H. Garman gave an account of this species and its injuries in Kentucky in the Second Annual Report of the Agricultural Experiment Station of that State for 1889 (pp. 30, 31). He observed the beetles on tobacco, and stated that the small holes which they gnawed in the leaves in some instances marred their value seriously. The same writer briefly mentioned injury by this species to potato (Bull. 61, Ky. Agl. Expt. Sta., p. 16).

In 1893 Dr. C. V. Riley stated, in a short note on this beetle, that it "did considerable damage to tobacco plants grown at the [Maryland Experiment] station by eating small holes in the leaves, giving them an unsightly appearance, which naturally reduced materially the value of the crop" (Bull. 23, Md. Agl. Expt. Sta., p. 89). The same year Mr. F. M. Webster briefly said of this species (Insect Life, Vol. VI, p. 186) that "the adults worked considerable injury to tobacco in southwestern Ohio by eating numerous holes in the leaves."

Some notes published recently would appear to indicate that this beetle, although injurious, is not wholly useless, though the damage which it causes probably exceeds any benefit derived through its work. At a meeting of the Cambridge Entomological Club, held January 10, 1896, Mr. S. H. Scudder exhibited the work of what was presumed to be *Epitrix parvula* on tobacco leaves, received from Mr. S. E. Elmore, of Hartford, Conn. According to the latter, this insect "eats a small

bit from the leaf of growing tobacco, leaving a light brown spot upon the leaf when ready for market; these spots materially increase the market value of the crop. . . If they could be successfully cultivated it would be a boon to the tobacco grower" (Psyche, Vol. VII, p. 347). Mr. Schwarz is reported as saying that the yellow spots above mentioned are due to fungus as the beetle eats through the leaf (Proc. Ent. Soc. Wash., Vol. IV, p. 33). It is also stated by Messrs. Hopkins and Rumsey (Bul. 44, W. Va. Agric. Exp. Sta., p. 306) that this insect, although a common tobacco pest which quite often caused serious damage to the leaves, is also the source of "what is known as spotted tobacco wrapper, which is considered ornamental for cigars, and is in demand on this account. This condition is caused when spots are eaten in the surface and do not extend through the leaf." The same authors write that it "is very injurious to young and old tomato and egg plants, eating the surface of the leaf or penetrating it with numerous holes, causing it to have a whitish, sickly appearance," and that the species had been common and quite troublesome at the Experiment Station of that State for a few years back (*l. c.*, p. 302).

From the association of this species with injury to tobacco it has been appropriately named the tobacco flea-beetle. It feeds, apparently, in the adult stage at least, on all the Solanaceæ, both cultivated and wild.

REMEDIES.

Pyrethrum mixed with about ten parts of flour or road dust has been recommended for this flea-beetle; but there is an objection to this in that it necessitates too frequent application for profit.

Bordeaux mixture and Paris green, combined or alone, have produced the best results.

NOTES ON THE STRAWBERRY WEEVIL: ITS INJURIES AND BIBLIOGRAPHY.

By F. H. Chittenden.

Through the medium of the issuance of Circular No. 21 upon the strawberry weevil (*Anthonomus signatus* Say) considerable information was gathered in regard to the injuries and distribution of this species. In Virginia and Maryland the usual amount of injury was reported, and in addition damage to blackberries was reported in Texas,—an extreme southern and unexpected locality for injuries by this insect.

Letters of inquiry were received during July, with specimens, from Mr. R. H. Price, of the Texas Agricultural Experiment Station, and from Mr. M. V. Slingerland, of the Cornell University Experiment Station, reporting damage in Texas, and further correspondence brought out the fact that the insect was doing considerable damage in some portions of that State. Mr. James Nimon, of Denison, Tex., wrote, April 24: "I know to my sorrow that this species is one of the most destructive little things I have had to deal with for some time. I first

noticed (in 1896) that many of the blossom buds on dewberries turned brown, looking as though they had been blighted. * * * It commences work as soon as the buds appear and continues as long as there is a bud left to work on. On one occasion I collected 150 cut buds from a single plant and two days later 60 more. More than three-fourths of my crop has been destroyed this year. They appear to be worse on dewberries than upon the upright or bush blackberries, but I discovered no signs of their work on strawberries." Mr. L. W. Clarke, of the same locality, wrote on April 28 that this species was cutting blackberry buds just before blossoming, and that it seriously threatened the destruction of the crop in his vicinity. Mr. E. P. Stiles, editor of the "Horticultural Gleaner," Austin, Tex., wrote that at Sherman, in the northeastern part of the State, this species appeared in destructive numbers and entirely destroyed the blackberry crop of one of his correspondents. Only 2 gallons of berries were gathered from 2 acres.

In Maryland, Mr. W. G. Johnson, of the Maryland Agricultural Experiment Station, has reported this species as destroying about a third of the crop in portions of Anne Arundel, Prince George, and Caroline counties. Mr. James S. Robinson, horticulturist of the same station, cited a case where the loss on a patch of the Michel variety reached 50 per cent. In the neighborhood of Church Hill, Queen Anne County, Mr. Fred Minch and others reported damage. In 1896 the gentleman mentioned lost his entire crop. Paris green had been tried, but too late to be of any benefit, although it was noticed to have killed a great many of the insects. In this locality the insect was known as "the saw fly," but the description of its manner of work plainly indicates that the insect noted was the strawberry weevil. Mr. J. S. Lapham, of Goldsboro, Caroline County, reported the weevil present in his vicinity, and that the Lady Thompson variety was most susceptible to its attack. Mr. Henry C. Hallowell stated that the insect had been present in his neighborhood in recent years and had injured about one-half of the crop in the vicinity of Sandy Spring, Montgomery County. Hon. W. D. Pyles wrote from Silver Hill, Prince George County, where the strawberry weevil was first reported as an injurious species, that it had done considerable damage there for several years. He believed that tobacco dust and fertilizers spread lightly over the vines from the time of blooming till the berry is of the size of a marble was of some value as a deterrent, but that nothing that was tried entirely eradicated the insects.

In Virginia, Mr. Frank L. Birch sent specimens from Falls Church, with the report that the insect had been very destructive for the past four years at that place. Mr. John B. Ferratt, of Norfolk, stated that in the year 1892, he lost 12 acres of strawberry plants by this beetle. He plowed the plants under and applied 50 bushels of fresh-burnt oyster-shell lime to each acre, and reports that since that time he has never seen or heard of any more of the beetles in Norfolk

County. Our correspondent further writes that in that county and in the adjoining county of Princess Anne, in what is one of the greatest strawberry-growing sections of the South, most of the crops are well cultivated, and it has been found that as a consequence they are seldom annoyed by insects.

In Pennsylvania, Mr. Frank W. Sempers, Doylestown, Bucks County, an entomologist of considerable reputation, reported the weevil at work in 1894. He writes: "The infested plants were sprayed with Bordeaux mixture, to which paris green was added, and this treatment apparently put an end to their work." The species was not noticed doing injury there, however, this year. May 6 Mr. John Waltz wrote from Catawissa, Columbia County, that this insect, which he described, was destroying his crop for the year, and that it had been doing so for several years. May 24 he sent a specimen of the insect found on strawberry at Blythedale, Md.

John C. Andrus reported the species at Carbondale, Ill., and St. Louis, Mo. Mr. W. Brodie, an entomologist of Toronto, Canada, reported the weevil present in strawberry patches around Toronto, but not injurious to any extent, and Mr. Charles Dury, also an entomologist, reported that the species was always abundant about Cincinnati, Ohio, although no damage had come to his notice.

LIST OF THE MORE IMPORTANT WRITINGS ON THE STRAWBERRY WEEVIL.

1. SAY, THOMAS.—Curculionides, July, 1831, p. 293; Lec. ed., v. I, p. 293.

Original description of *Anthonomus signatus*.

2. GLOVER, T.—Report Department Agriculture, Nov.-Dec., 1871, p. 479, 1 fig.

Account of injury to strawberry at Silver Hill, Md.; no traces of eggs or larvæ; species identified as *Anthonomus signatus* Say.

3. GLOVER, T.—Report Commissioner Agriculture for 1871 (1872), p. 73, 1 fig.

Transcript of Glover's first article, with additional short paragraph on remedies.

4. LECONTE and HORN.—The Rhynchophora of America north of Mexico. Proc. Am. Phil. Soc., v. XV, p. 199 (Dec., 1876).

Descriptive notes and references to systematic literature.

5. COOK, A. J.—Thirteenth Rept. Sec'y. State Hort. Soc. Mich. for 1883 (1884), pp. 154, 155, 1 fig.

Short account of injurious appearance at Phœnix, Mich. (Upper Peninsula); species identified as *Anthonomus musculus* Say; description quoted.

6. FORBES, S. A.—Thirteenth Rept. State Entomologist Illinois for 1883 (1884), pp. 114, 115.

A mere quotation of Professor Cook's article.

7. SAUNDERS, WILLIAM.—Canadian Entomologist, v. XVII, pp. 239, 240, Dec., 1885; 16th Ann. Rept. Ent. Soc. Ontario, 1886, pp. 6, 7.

Report of an injurious occurrence at Barrie, Ontario, Canada, in 1885; method of work of adult described.

8. RILEY, C. V.—Report Commissioner of Agriculture for 1885 (1886), pp. 276–282, 2 figs.

Summary of past history; report of injuries on Staten Island, New York, in 1884 and 1885; summary of natural history of other species of Anthonomus; remedies; characters, synonymy, and descriptions of the species and its color varieties; comparative table of *A. musculus* Say and. *A suturalis* Lec.

9. LINTNER, J. A.—Third Rept. St. Entom. New York for 1886 (1887), p. 139.

Notice of Riley's account of injury on Staten Island in 1884 and reference to Cook's report (see No. 5).

10. FLETCHER, JAS.—Report Experimental Farms, Canada for 1887 (1888), p. 37.

Brief mention of injury to strawberries at Cowansville, Province of Quebec, in 1887.

11. KRIEG, LAWRENCE J.—Insect Life, v. I, p. 85. Sept., 1888.

A letter announcing damage at Ætna, Allegheny County, Pa., in 1885 and 1887, amounting "to hundreds of dollars on single plantations" during the latter year.

12. COOK, A. J.—First Rept. Agl. Expt. Station Agl. Coll. Mich. for 1888 (1889), pp. 165–166, 1 fig.

Brief reference to former appearance and of damage in 1888 at Pontiac, Oakland County, Mich.

13. FLETCHER, JAS.—Rept. Exptl. Farms Canada for 1890 (1891), pp. 173–175.

Account of life history based on observations in conjunction with W. A. Hale, of Cowansville, Province of Quebec, Canada; the latter had suffered from the insect's ravages for several years; years of injury specifically stated are 1888, 1889, and 1890; 1887 comparatively free from pest; injury at Hamilton, Ontario, in 1886 also referred to.

14. LINTNER, J. A.—Country Gentleman, June, 1891; reprint.—Eighth Rept. State Entom. New York, for 1891 (1893).

Abstract of letter from Wellham's Crossroads, Md., complaining of an insect "that stings the stem of strawberry blossoms," etc. As no specimens accompanied this letter, Dr. Lintner surmised the species to be *Corimelæna pulicaria*, but the description of the injury agrees perfectly with that of *Anthonomus signatus*.

15. DIMMOCK, GEO.—Insect Life, v. IV, p. 76. Oct. 1891.

A mere statement of destruction to buds of blackberries, especially Wachusett variety, at Canobie Lake, N. H., in 1891.

16. BRUNER, L.—Ann. Rept. Nebraska State Hort. Soc. for 1891 (1892), pp. 228–229.

No original observations; life history not known to writer.

17. DIETZ, WM. G.—Trans. American Entomological Society, v. XVIII, pp. 215–217, Pl. vi, fig. 15. July, 1891.

Detailed descriptions of *Anthonomus signatus* and *musculus;* differences between the two species are indicated.

18. HAMILTON, JOHN.—Canadian Entomologist, v. XXIV, pp. 41–42. Feb., 1892.

A discussion of the specific name of the strawberry weevil, no conclusion being reached. Notes on the occurrences of the adults of *Anthonomus musculus* and *A. signatus*, the former on huckleberry, the latter on Tilia, Rhus, and Rubus.

19. BECKWITH, M. H.—Del. Coll. Agl. Expt. Station, Bul. XVIII, pp. 11–16, figs. 2 (after Riley). Sept., 1892. Report of the Entomologist, Fifth Ann. Rept. Delaware Coll. Agl. Expt. Station 1892 (1893), p. 103. Rev.–Insect Life, v. IV, pp. 169, 217; Ent. News, v. III, pp. 262–263. Dec., 1892.

Past history and description of species (quoted from Riley); detailed account of injuries near Dover, Hartly, Camden, Wyoming, Smyrna, and Clayton, Del. Brief account of rearing experiments. Kerosene emulsion and white hellebore suggested as remedies; arsenites discountenanced for fear of poisoning.

20. CHITTENDEN, F. H.—Insect Life v. V, pp. 167–186, 5 figs. (3 orig.), Jan., 1893. Rev. — J. B. Smith, Ent. News, v. IV (Mar. 1893), pp. 88, 89.

Review of past history; detailed account of extensive damage in 1892 in portions of Maryland and Virginia; nature of injury; in direct proportion to the amount of pollen developed, which explains the greater susceptibility of staminate varieties; insect found to develop in wild strawberry, blackberry, and cinquefoil; species identified as *Anthonomus signatus* Say*; egg, larva, and pupa described and figured; habits and life history detailed; four species of parasites reared; as remedies it is particularly advised to destroy old and wild strawberry vines and blackberry bushes in the neighborhood of bearing vines; to use earliest staminates as traps for hibernated beetles, and wild bergamot for new brood; or to protect beds with a cloth covering. Descriptions by W. H. Ashmead of the parasites, *Bracon anthonomi* and *Catolaccus anthonomi* are appended.

21. RILEY, C. V.—Ann. Rept. U. S. Dept. Agriculture for 1892 (1893), pp. 162–163, pl. IV, figs. 1–5.

Brief summary of the season's observations and consideration of remedies.

22. WEBSTER, F. M.—Bul. 45, Ohio Agl. Expt. Station, p. 205, 1893, 2 figs.

Mention of this insect as an enemy to blackberry on the authority of Dr. Dimmock's letter in Insect Life (vol. IV, p. 76).

23. SEMPERS, FRANK W.—Injurious Insects and the Use of Insecticides, 1894, p. 95, 1 fig.

A brief compilation from Beckwith (No. 19).

24. SMITH, JOHN B.—Rept. New Jersey Agl. Coll. Expt. Sta. for 1893 (1894), pp. 470–473, 4 figs.

Notices of injuries in southern New Jersey, and short account of the species.

25. BECKWITH, M. H.—Report of the Entomologist, Sixth Ann. Rept., Delaware Coll. Agl. Expt. Sta. 1893 (1894), p. 166.

Short note on occurrence in strawberry fields in Delaware; caused considerable damage near Clayton; no decided benefit shown by the yield of fruit from rows treated with Bordeaux mixture "to which white hellebore and in some instances Paris green was added."

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*In all previous articles, except the first four, the species was referred to *Anthonomus musculus* Say.

26. CHITTENDEN, F. H.—Insect Life, v. VII, pp. 14–23. Oct. 22, 1894. Rev.–25th Ann. Rept. Ent. Soc. Ont. for 1894. Expt. Sta. Record, vol. VI, p. 562.

Account of infestation in Maryland, Virginia, Pennsylvania, Delaware, and New Jersey, in 1893 and 1894; redbud, dewberry, and "black cap" raspberry, named as new food plants, and two species of ants as enemies; early appearance and habits of adults; life cycle ascertained to be from twenty-eight to thirty days; process of oviposition described; summary of injurious appearances from 1871 to 1894; as remedies, "burning over," trap crops, sweep-net, dusting with lime, etc., arsenical and kerosene spraying and covering beds are considered; spraying experiments showed good results, particularly with Paris green; fruit growers urged not to trust entirely to staminate varieties.

27. BECKWITH, M. H.—Delaware Coll. Agl. Expt. Sta., Bul. XXVIII, p. 16. July, 1895.

Short note; little injury in Delaware in 1895; recommends mowing and burning over fields after picking fruit.

28. JOHNSON, W. G.—Bul. No. 6, n. s., Div. Entomology, U. S. Dept. Agriculture, p. 65. Dec. 28, 1896.

Brief mention of injuries in Prince George and Montgomery counties, Md.

29. SMITH, JOHN B.—Economic Entomology, p. 231. 1896.

A short popular account.

30. CHITTENDEN, F. H.—Bul. No. 7, n. s., Division of Entomology, U. S. Dept. Agriculture, pp. 78–79. Feb. 25, 1897.

Instances damage by this insect in May, 1896, at Cherry Dale and Marshall, Va., Wadalin, N. Y., and in the vicinity of Baltimore, Md.

31. CHITTENDEN, F. H.—Circular No. 21, 2nd ser., Div. Entomology, U. S. Department of Agriculture, pp. 1–7. Apr. 14, 1897.

A condensed account based upon the same author's previous writings with consideration of same remedies, but with the suggested trial of carbolic acid and Bordeaux mixture as repellants.

32. JOHNSON, W. G.—Bul. No. 9, n. s., Div. Entomology, U. S. Department Agriculture, p. 82. Oct. 21, 1897.

The species "made its usual attack upon strawberries, and in many parts of Anne Arundel, Prince George, and Caroline counties cut the crop fully one-third."

GENERAL NOTES.

A PECULIAR DAMAGE TO THE APPLE.

We show in the accompanying illustration an apple received July 7 of the present year from Mr. C. D. Bowen, of Richview, Washington County, Ill. It was a small green apple, under the skin of which a larva had been mining. The larva was lost by Mr. Bowen before the apple was sent, but a cast head found in the mine indicates that the insect which did the damage belongs to the genus Lithocolletis. The mine was long, narrow, and winding. Its color was pale drab, with a brown streak, produced by the excrement of the larva along its center. Nothing of this kind had ever been brought to our notice before. We know of no miner under the skin of the fruit, and there is no leaf-miner on apple which makes this kind of a mine. There are serpentine larval mines in other rosaceous plants, but none of this exact character. The

figure and this note are published in order to call the attention of entomologists and apple growers to what seems to be a new apple enemy. The gentlemen in the Pomological Division of the Department have occasionally seen similar mines under the skin of apples, and an effort will be made to secure living specimens in order to rear the adult insect. Mr. W. P. Corsa, of that division, brought us in November, from Milford, Del., apple twigs containing similar serpentine mines under the bark which may possibly have been made by the same species. The larva of *Gracillaria fasciella* Cham. makes very similar mines under the skin of young willow twigs, according to Mr. Pergande's observations.

ANOTHER LEAD-BORING INSECT.

In the pages of Insect Life we have referred to two cases in which insects had been found to bore into lead. The first case was that of a Cossus larva, which had bored its way through a large leaden bullet, which was embedded in an oak tree in which the larva was living. The second was that of a coleopterous larva, which had bored through a section of lead piping, and which was communicated to us by Prof. A. J. Cook.

FIG. 19.—Apple showing work of some unknown species of leaf-miner (original).

A new case was brought to our attention during the autumn of 1896, and as it was an instance in which expert testimony prevented litigation, it is worthy of record.

A prominent firm of plumbers in a western city lined a tank with sheet lead in 1894. In 1896 the tank was observed to leak, and the hole which was found was supposed to have been made by a carpenter's compass having been dropped into the tank, thus piercing the lead. Several weeks later another leak of the same appearance was observed close to the first one, and when the third leak was reported it was of such a serious nature as to flood ceilings and soak furniture, carpets, etc., damaging them to the extent of $200 or $300. An investigation was begun. A strip of the sheet lead was cut out and a large number of holes were found, some entirely through the lead, some only part of the way through, and others in the form of grooves running lengthwise. Underneath each hole or groove a burrow was found directly opposite in the wood, with wood dust in the holes. Another plumber was called in by the owner, and he stated that, in his opinion, the lead had been carelessly laid on wood on which there must have been fine gravel, and in pounding or dressing the lead out to a smooth surface the stones had

pierced or nearly pierced the lead. The owner accepted this evidence and talked about the matter among the best architects in the city, some of whom gave it as their opinion that the trouble was due to defective workmanship or material, and as a result the original plumbing firm received the most unfortunate free advertising of a disagreeable nature. Local experts were called in, but the owner refused to accept their decision, and the matter was finally referred to this office. Both parties agreed to abide by the decision rendered. It was at once evident that the wood had contained the larvæ of some species of powder-post beetle of the genus Lyctus, that the damage was caused entirely by these insects, and that, therefore, it could not be attributed to lack of skill or foresight on the part of the plumber.

ICERYA PURCHASI IN PORTUGAL AND THE AZORES.

In Volume III of Insect Life (p. 105) the writer, in a dual article with the late Dr. Riley, catalogued the species of Icerya and gave as the distribution of *I. purchasi*, Australia, South Africa, New Zealand, California, and Mexico. Since the publication of this article no announcement has been made of the occurrence of the insect in other countries until within the last year or so reports have been published of its occurrence in the Azores Islands, and particularly on the island of San Miguel. Dr. Francisco A. Chaves, of the Meteorological Observatory, Ponta Delgada, in correspondence with the writer has recently assured him that the insect does not occur on San Miguel, but that the scale which is injuring orange trees at that place is *Mytilaspis citricola*. During the present month (February, 1897) specimens have been received from Senhor Armando da Silva which were found upon orange trees on the right bank of the river Tagus, near Lisbon, Portugal, which proved upon examination to be *Icerya purchasi*. Professor da Silva in the meantime had published in the "Annaes de Sciencias Naturæs" (Porto, October, 1896, pp. 224–227) an important article, in which he gives the facts not only regarding this occurrence of the scale in Portugal, but also evidence which seems to prove that the rumors concerning the Azores were perfectly correct. Professor da Silva is familiar with all the literature of this insect. The species was found in Portugal last May upon branches of Acacia and later appears to have been found upon oranges. Professor da Silva points out that in 1848–49 a writer in the "Revista Universal Lisbonense" remarked that an insect rather scarce and unknown to most zoologists, which attacked Azorian oranges, might be a species belonging to the new genus Dorthesia. In 1878 Senhor Joao Machado de Faria e Maya is said to have recognized the existence of *Icerya purchasi* upon oranges on the island of San Miguel, and in visiting California in 1885 he verified the exactitude of the preceding determination.[1]

[1] There must be some mistake about the earlier date, since Maskell's original description was only published in 1878 and did not reach the attention of entomologists until a year or two later.

The introduction of Icerya into the Azores is, according to Professor da Silva, a fact which is of easy explanation. The orange trees in these islands, exposed to the danger of being mutilated and torn by the winds, have been protected by planting certain trees around them. *Acacia melanoxylon* and *Carinocarpus lævigatus*, Australian trees, were chosen for this purpose. These trees could have served to transport the insect. There seems some chance, however, that the insect was imported as early as 1837–38 at Fayal, but in the opinion of the writer the insect which damaged the orange trees at that time was another species.

We have advised the introduction of *Vedalia cardinalis* into Portugal, and, through the kindness of the State board of horticulture of California, we have been able to send two shipments of this beneficial lady-bird to Senhor Alfredo Carlos Le Coq, of the bureau of agriculture at Lisbon.

A LITTLE-KNOWN TINEID MOTH OF INDOOR HABITS.

A little tineid moth catalogued in the "List of Lepidoptera of Boreal America" as *Tinea ferruginella* Huebn., was reared during May of 1896 from a mass of sweepings containing refuse grain, hay, and other similar material taken from the floor of a Washington feed store. About the same time other individuals were noticed flying about the lights in the writer's room, and later this species was noticed in abundance at the electric lights in the business portion of this city. Captured moths oviposited freely, but for some reason the moth does not appear to have yet been reared *ab ovo* neither here nor elsewhere. Among the divisional records is one of this species having bred March 4 from dried leaves in a rearing jar, and in another instance the adult was reared from the larva.

July 16, 1896, a larva was found by Mr. C. L. Marlatt in its case crawling upon the floor of the basement of the Department insectary. It was confined in a jar with dry clover and similar material, and the moth issued August 6. During the first week of September of the following year numerous larval cases of this tineid were gathered from a different basement connected with this office.

The adult insect has been observed commonly indoors at Washington from March 4 to December 7. It will be seen that it is to be found nearly the year round, and occurs also most everywhere in habitations and in other buildings.

In Brackenridge Clemens's "Contributions to American Lepidopterology," published in 1859, this species was described as new under the name *Tinea crocicapitella*, and in 1882 Lord Walsingham identified this with the European *Blabophanes ferruginella* Huebn. (Trans. Am. Ent. Soc., Vol. X, p. 170). Neither of the above writers mentioned either locality, occurrence, or habits, and nothing, so far as the writer is aware, has been published concerning the habits of this species in American literature and only brief mention is made of it in foreign

works. According to European writers, the larva has been reared from a case on seeds of Artemisia, but this is somewhat unsatisfactory, as there is some doubt as to the exact nature of the larval food.

The larval case is not unlike that of the clothes moth, *Tinea pellionella*. It measures, when completed, from 8 to 11 mm in length and 2 to 3 mm in breadth, being about four times as long as wide. It is about half as thick as wide, and the sides are nearly parallel, the narrowest portion being usually at the mouth or place of exit and the widest near the middle. It is dirty dark gray in color and is composed of fine particles of dust and such other material as naturally accumulates in the corners of a room, joined together with silken webbing and sparsely interspersed with larval excremental pellets.

When at rest on the walls or elsewhere in rooms, and still more when in flight, it is not without close examination that this species can be distinguished from its cousins, the clothes moths, *T. pellionella* and *T. biselliella*, and it often pays the penalty for this resemblance when it ventures within the vision of the wrathful housewife. The mounted moth, however, is not liable to be mistaken by an entomologist for any other indoor species. It is about the same size as the common clothes moth, *Tineola biselliella*, exhibiting the same variation in size. It may be recognized by the fore-wings, which are nearly covered with blackish scales, except a broad, yellowish dorsal streak and a conspicuous subhyaline median discal spot.

In addition to the material captured and reared in the District of Columbia there are specimens in the National collection from Kirkwood, Mo., Wyandotte Cave, Kentucky, and California—evidence of a wide distribution in this country. It is a true cosmopolite, and to be found almost everywhere. Abroad it is known in central and southern Europe, Great Britain and Ireland, Asia Minor, North Africa, Australia, and New Zealand.

European systematists place this species in the genus Monopis, Huebn.—[F. H. C.]

ANOTHER MOTH LIKELY TO BE MISTAKEN FOR TINEA GRANELLA.

To the list of moths of the genus Tinea enumerated in Bulletin No. 8, n. s. (p. 35), as liable to be mistaken for *Tinea granella* Linn., the European grain moth, *T. misella* Zell, should be added. Of this species Mr. C. S. Gregson is quoted in the Entomologist's Annual for 1857 (p. 121) as follows: "I have bred it from unthrashed wheat this year; it made up in the head and fed upon the grain. I formerly bred it from the interior of bean stalks, for, seeing the pupa cases projecting from the stalks, I split up several stems and so found the larva."—[F. H. C.]

PARASITES OF BEAN AND COWPEA WEEVILS.

It has always been a matter of surprise and comment that our common bean and pea weevils were not parasitized, since the allied cowpea weevils and various other bruchids that attack only wild plants were known to have chalcidid parasites which preyed upon them, often in great numbers. During the year that has just passed the writer was successful in rearing a parasite of the bean weevil, and the occasion is taken to present notes on all the parasites of the legume-feeding bruchids which have been identified at this time. The determinations of the parasites are by Mr. W. H. Ashmead.

Eupelmus cyaniceps Ashm.—September 27, 1897, the writer reared what is probably the first parasite known of the weevil, *Bruchus obtectus* Say. It was in beans brought to this office by Mr. Frank Benton from Berwyn, Md., and it occurred in some numbers. This species has previously been mentioned by the writer as having bred from the seed pods of false indigo (*Amorpha fruticosa*) inhabited by *Bruchus exiguus* (Insect Life, Vol. V, p. 250).

Bruchobius laticollis Ashm.—October 18, dead specimens were received from Dr. C. F. Parker, Mentone, Ala., with living individuals of the beetle of *Bruchus obtectus* in beans. This is a common parasite of *Bruchus 4-maculatus*. The Department has received specimens from several localities in beans and cowpeas infested by this latter weevil, among which may be mentioned Washington, D. C., Lake City, Fla., and Chicago, Ill. At the last-mentioned place numerous specimens were taken in seed from Brazil exhibited at the Columbian Exposition. At the Atlanta Exposition the species occurred in material from Venezuela.

Cephalonomia sp.—A single example reared from beans from Venezuela, infested by *B. 4-maculatus* and exhibited at the Columbian Exposition.

Aplastomorpha prattii Ashm. MS. was reared from *Bruchus 4-maculatus* in cowpeas brought to the Division by Mr. F. C. Pratt from a store at Washington, D. C., November, 1896.—[F. H. C.]

INJURY BY THE WESTERN FLEA-BEETLE, PHYLLOTRETA PUSILLA HORN.

July 10, 1897, specimens of the small blackish flea-beetle known as *Phyllotreta pusilla* were received from Mr. D. A. Piercy, Kennedy, Nebr., with the accompanying statement that the species had destroyed between 10 and 20 acres of corn in twenty-four hours. In gardens they were stated to destroy everything. They came in swarms of black clouds and covered the plants. Our correspondent writes that a strong solution of soapsuds killed the beetles instantly, and that a mixture of fresh cow manure, wet up so as to be sprinkled on the plants with a brush or coarse sprinkler, would also drive the beetles away.

Later in the month Mr. Benjamin F. Henry, of Hill City, S. Dak., complained of a "flea"—a name commonly applied by farmers to flea

beetles—that was troublesome on cabbage and other cruciferous crops in his vicinity. At our request he sent specimens of the insect, which proved to be also *Phyllotreta pusilla*, with the statement that only a single grower in his neighborhood had saved any cabbage, all others having given up the fight against this flea beetle. In addition to cabbage this species was injurious to radish, horseradish, and turnip, and was stated also to injure peas. On the last-mentioned plant they ate the lower leaves or lower part of the stalk. Out of a thousand good cabbage plants our correspondent saved only a hundred. The beetles seemed to prefer the younger plants, but thrive also upon the older ones. A neighbor of our correspondent reported that he had not raised a turnip for seven years on account of this insect. The species was stated to prevail in injurious abundance throughout the region of the Black Hills. The beetles were first noticed the last week of June, and seemed to disappear somewhat toward the end of July.

THE WINDROW REMEDY FOR BLISTER BEETLES.

Correspondence of this Division and readers of Insect Life will remember that we have often recommended as a remedy against blister beetles to drive them into windrows of hay, straw, or other light material and then destroy them by setting the material on fire. Very recently somebody doubted the value of this expedient; so, on the next occasion of reported blister beetle damage in a locality where these insects occurred in great abundance, we requested information concerning the value of this remedy, which we had recommended in a letter of May 22. Our correspondent, Mr. E. W. King, of Lostprong, Tex., was troubled with *Epicauta lemniscata*, which was very destructive to beets, potatoes, cabbage, and corn upon his place, but it was also very abundant on "careless weed," this latter habit being convenient for the experiment. Under date of June 3, Mr. King writes as follows:

"We took some old hay out of the barn, made windrows about 18 inches high, 2 feet wide, and 40 feet long and commenced to 'switch' them into the loose hay. A stiff breeze was blowing and we burned *millions*, as they drive easily. Of course we did not kill all, but, strange to say, they have entirely disappeared from this ranch."

WHITE GRUBS OF ALLORHINA NITIDA INVADING A CELLAR.

August 19 Hon. William P. Miller, of Harrisburg, Pa., sent to this office a box of specimens containing the larvæ and an imago of the green June beetle, *Allorhina nitida*, with the information that the larvæ which were infesting the grass in the lawn about his house had formed the disagreeable habit of burrowing through tiny crevices in the foundations of the walls and entering the cellar, where they meandered around on the cemented floor, causing great annoyance. The worm did no damage in the cellar, but was considered a great nuisance. Our correspondent writes that as many as 40 of these grubs were caught in twenty-four hours in the cellar.

In answer to our inference that manure might have been used on the lawn and that the insects were thus conveyed to it, Mr. Miller wrote, under date of August 25, that such was not the case, but our theory that there might be decaying vegetable matter in the soil was correct. Four large maple trees had been cut down on this lawn, all more or less rotten, and the roots of these were still in the ground. All of this goes to support our assumption that the white grubs of this species feed upon vegetable humus rather than upon living roots or similar vegetation. Mr. Miller further writes that about thirty specimens of the larvæ were captured while they were crossing bins of coal. By listening closely a lump of coal would be heard to move. Locating the direction and watching the coal the lump would be seen moving. The larvæ were captured under these lumps.

REPORTED DAMAGE BY THE GREEN PLANT-BUG, LIODERMA UHLERI STAL.

June 30, 1897, Mr. Peter Nieveen, of Nieveen, S. Dak., wrote to this Division that the above species was doing great damage to all kinds of grain in his section of Charles Mix County. He said that the species had been observed along the Missouri River banks for several years on trees, but they did no damage to crops until the year 1896. Some farmers, our correspondent stated, had lost nearly all of their corn and wheat. A field of oats invaded by them was observed to be about two-thirds destroyed in just a week from the time that the insects were first noticed.

September 6, 1897, Mr. De Alton Saunders, botanist and entomologist of the experiment station of South Dakota, located at Brookings, wrote that he had visited the infested region and that this plant-bug was doing all that had been claimed concerning it.

There are Divisional records of the receipt of this species during the past two years from E. S. Richman, of Logan, Utah, who sent specimens with the report that the species was doing considerable injury to wheat in Millard County, Utah, and from Mr. R. H. Price, of the Texas Agricultural Experiment Station at College Station, who reports, under date of September 16, 1895, that this species was responsible for the destruction of 40 acres of peas and 2 acres of lima beans at Toyahvale, Tex. In addition to the localities mentioned, it should be stated that this species was described originally from Mexico, and that it was recorded also from Colorado, and that we have received it from Tucson, Ariz.

ON THE FOOD HABITS OF THE HARLEQUIN CABBAGE BUG.

Since the recorded occurrence of *Murgantia histrionica* Hahn, upon asparagus and other plants by the writer in Bulletin No. 7, new series, of this Division (p. 80), a number of new observations have been made upon its food habits. This insect is now present on every farm and

garden within several miles of Washington in which cruciferous plants are grown that the writer and other members of the Division have had occasion to visit, and is, everything considered, by far the worst insect pest with which the farmer has to deal. It is known locally as the "terrapin bug," which is often shortened to "tar'pin bug," and in some localities is called "fire bug," both names sufficiently suggestive as to require no explanation.

Injury is very noticeable on horseradish, and if the species keeps on at the present rate, without an effort being made to suppress it, in a few years it will be almost impossible to grow this condiment in this vicinity. The farmers, generally, have not awakened to the occasion, and have taken no measures whatever for the insect's suppression beyond occasional hand-picking.

The experience of recent years shows that it is the rule with this species, when it has exhausted cruciferous crops, to attack whatever other succulent plant is most available and palatable.

On one farm at Tennallytown, D. C., an entire field of 10,000 cabbage plants was completely ruined, and when visited the first week in October the field was deserted. An adjoining field of potatoes was next attacked, and also one of eggplant, and numerous individuals of this bug in all stages were observed sucking the juices of these plants. Unripe fruit of eggplant appeared to be particularly relished, and ripe pods of okra were occasionally attacked. The bugs are also very partial to certain wild plants, the pigweed (*Amarantus retroflexus*), wild lettuce (*Lactuca canadensis*), and lambsquarter (*Chenopodium*) being favorites. They congregate in all stages and on all parts of these plants, but appear to prefer the stems. The stems of beans were attacked, as were also the pods.

The value of a trap crop was exemplified the present year in a garden near Cabin John, Md. The insect was present in innumerable hordes upon a large plat of kale, and between this plat and the cabbage grown in the same garden a considerable space intervened. After the kale had matured and the seeds had formed, the insects still remained upon the plants, where they could readily have been killed with crude kerosene, strong kerosene emulsion, or by fire. They were permitted to remain there, however, and, in the course of time, found their way to the cabbage beds and to the radishes which grew near by.—[F. H. C.]

FOOD PLANTS OF THE "COTTON STAINER."

In Volume I, Insect Life (pp. 234–241), the editors published an article upon *Dysdercus suturellus*, especially in its relation to ripe oranges. It was there stated that the insect is found in the winter time in Florida upon two species of Hibiscus, upon Guava, upon *Urena lobata*, which is locally known as Spanish cocklebur, and upon *Solanum nigrum*, locally known as poisonous nightshade. Mr. B. M. Hampton, of Frostproof, Fla., has found this insect abundant and destructive upon certain

Tangerine orange trees during December, 1897. He found them also puncturing rosebuds and blossoms, the seed pods of the Jamaica Indian sorrel (*Hibiscus subdurifa*), the pods and blossoms of the oleander, and the ripe fruit of the tropical or melon papaw (*Carica papaya*). It has been supposed that the insect breeds normally upon certain wild species of Hibiscus, and it is important from a remedial standpoint that this breeding plant be ascertained.

COLLECTING LOCUST EGGS IN MOROCCO.

Mr. D. N. Burke, United States consul-general at Tangier, informed the Department of State, under date of March 19, 1897, that locusts had appeared in great numbers in the southwestern part of the Empire of Morocco. The foreign merchants of the coast towns and some of the farmers raised a fund by subscription to employ the poor of the different localities to gather the eggs and destroy them, just as in the past few years has been done by the French Government in Algiers. Up to March 12, Mr. Burke had been informed by the consular agent at Saffi, about 1,000 hundredweight had been gathered at a cost of about $900. The last price paid at Saffi was about 40 cents per hundredweight. It is estimated that each pound of eggs contains from 600 to 700 egg pods, and each of the pods about 90 eggs. The destruction of 1,000 hundredweight, therefore, means the destruction of nearly 6,000,000,000 locusts. In the collecting it is further estimated that almost an equal number of egg-pods are injured and destroyed by the natives in going over the ground while collecting and digging them up.

POISONING GRASSHOPPERS IN NATAL.

A modification of the bran-arsenic mash method of killing destructive locusts or grasshoppers, first used, we believe, in California against the "devastating locust" (*Melanoplus devastator*) and afterwards in Virginia against the "American locust" (*Schistocerca americana*), and since also used in different parts of the country as a remedy against cutworms, has recently been used to very good advantage in Natal against the migratory locust which occasionally ravages the cultivated plantations and which, during the last few years, have been especially numerous and destructive. The report has been published as a Government notice. The mixture used consists of 4 gallons of water, heated to a boiling point, to which 1 pound of caustic soda is added. As soon as this is dissolved, 1 pound of arsenic is added, after which the liquid is stirred and boiled for a few minutes, care being taken not to inhale the fumes. A half gallon of the resulting liquid is added to 4 gallons of hot or cold water with 10 pounds of brown sugar, or a half gallon of the poison is added to 5 gallons of treacle. Cornstalks, grass, or other vegetation dipped in this mixture, are placed along the roads and in the fields, and the liquid can also be splashed with a brush upon anything for which the locusts are known to have a liking. They will be attracted for a distance of as much as 100 yards and die

after eating. The dead bodies of those thus killed are eaten by other locusts and "in a few days' time the ground may become strewn with the dead bodies of the insects." These facts are gained from Nature, September 30, 1887.

COLLECTING GRASSHOPPERS IN NEW HAMPSHIRE.

It may not be generally known among entomologists that the State laws of New Hampshire provide for the paying of a bounty for all grasshoppers collected and destroyed in the months of June and July. The amount of such bounty is $1 for each bushel of grasshoppers, the payment to be made by the selectmen of the town in which the insects were destroyed. The amount which the State has expended in the eleven years—1885 to 1895—has not been great, and only reaches a total of 1,982¾ bushels, for which $1,982.77 has been paid by the State.

The number of bushels upon which bounties have been paid during these years have been as follows:

Year.	Bushels.	Amount.	Year.	Bushels.	Amount.
1885	907 9/10	$907.90	1892		
1886	542⅜	542.37	1893		
1887	268¾	268.75	1894	106	$106.00
1888	21	21.00	1895	40	40.00
1889	18½	18.50			
1890	75¼	75.25	Total	1,982.77	1,982.77
1891	3	3.00			

NOTES FROM CORRESPONDENCE.

Datana angusii injuring pecans in Mississippi.—Under date of August 26, 1897, Mr. John Kelly, of Mississippi City, Miss., wrote to this office that the caterpillars of *Datana angusii*, specimens of which he sent us, were very injurious in rows of pecan trees upon his own and neighboring plantations. At this time he states that 200 trees of from 15 to 20 years old in his own grove were very much injured, fully one-half of them being entirely defoliated, while the remainder were more or less affected. The insect, which he describes as a scourge, had not been noticed in that locality before. The insects were present only upon pecans, which were denuded in a very short time. Our correspondent was employing about the best remedy known for this species, namely, burning them from the branches, and he writes us that he had destroyed fully 2 bushels of these caterpillars. Every day a fresh colony was discovered until the time of writing.

Abundance of Catocala lacrymosa at Brookhaven, Miss.—July 1, 1897, Messrs. J. J. Stamps and Ira L. Parsons, of Brookhaven, Miss., sent specimens of *Catocala lacrymosa* Gn. to this office, with the statement that during the latter days of June only a few of these insects were to be seen, but that at the date of writing thousands appeared at noon during hot weather, invading the houses in hundreds, and that where the bark was knocked off the oak trees they congregated at dark in great numbers to suck the sap which oozed out. They were noticed all about that portion of the country, and were so numerous as to attract the attention of all observers.

The pear-tree borer in Mississippi.—A correspondent at Kirkwood, Miss., Mr. E. H. Anderson, wrote us, under date of June 18, 1897, of an insect that injuriously affected the pear in his vicinity. The accompanying specimens proved to be the larvæ of the pear-tree borer (*Sesia pyri* Harr.). This species is fairly abundant in

the Northern States, but Mississippi is, we believe, the farthest southern locality recorded for it.

Remedy for cabbage worms.—Mr. George W. Nutze, of Sullivan, Ind., writes, under date of August 2, 1879, that he has rid his cabbage patch of worms by spraying with the following mixtures:

One-fourth pound powdered alum.
One pound coarse salt.
One pound slacked lime.
Dissolved in one-half gallon hot water.

Applied at the rate of about three fluid ounces to a bucket of water.

The rice grub beetle at electric lights in New Orleans.—Under date of September 14, 1897, Mr. Chris. V. Haile, of New Orleans, La., writes that the beetles of the rice grub *Chalepus trachypygus*, specimens of which were sent, were swarming during the first week of September in great numbers about the electric lights of his city, and that the ground was covered with their dead bodies. He writes: "They were swept up in piles to be carted away, and when left too long the stench was almost unbearable. Whenever mashed on the pavement a large greasespot was made, and at the street intersections, where the electric cars stopped to put off passengers, the rails were so greasy that it was difficult to again start the cars. The beetles reappeared last night, but the swarms around the electric lights were not quite so dense."

Injury by the bark-beetle, Dendroctonus rufipennis.—Under date of June 5, 1897 Mr. Austin Cary writes from Colebrook, N. H., that the above-mentioned species of scolytid bark-beetle, specimens of which he sends, has been found in spruce timber in his vicinity, where it is apparently the cause of considerable injury. It is present in a tract of virgin timber, upon which many trees, single and in groups, are dead; others are just dying or are partially affected. Reports of injury by this species are comparatively rare. We have received the species from Lafayette, Ind., from Mr. F. M. Webster. Mr. Harrington has observed it to be very injurious to tamarack in Canada, and Mr. Schwarz, to the same tree in Michigan and to Engelmann's spruce (*Picea engelmanni*) in the Wasatch Mountains of Utah.

Injuriousness of Pieris protodice.—Specimens of the cabbage butterfly, *Pieris protodice*, were received during August, 1897, from Dr. Richard E. Kunzé, with the statement that the species is very injurious to seedling plants of cauliflower and cabbage in the Salt River Valley, in the neighborhood of Phœnix, Ariz., where it was reported to have destroyed between 75,000 and 100,000 plants. The caterpillars appeared to prefer the cauliflower to the cabbage.

Injury by the silver-pine tortricid to Douglas spruce in Oregon.—Mr. Lincoln Taylor, of Cottage Grove, Oreg., writes, under date of September 3, that the so-called silver-pine tortricid, *Grapholitha bracteatana* Fern., has been very injurious to the cones of the Douglas spruce, *Pseudotsuga douglasii*, in his vicinity. Our correspondent was gathering the seed for market, and found that this insect, with the larvæ of a cecidomyiid fly which accompanied it, had injured about one-half the present season's crop of seed.

Heterocampa manteo on oak.—November 18, 1897, Mr. James M. Kelley sent to this office the larvæ of *Heterocampa manteo*, with the report that they were destroying all the leaves on oak and black-jack at Damascus, Miss. In the notes of the Division this species is recorded to attack oak, persimmon, and walnut, larvæ having been found by Mr. Th. Pergande at different times from June 18 to September 29 on these trees in Virginia in the neighborhood of Washington.

The malodorous carabid, Nomius pygmaeus, in Oregon.—Through the kindness of Prof. Ramsey Wright we have received a specimen of *Nomius pygmaeus*, with a short note on its disagreeable odor, from Dr. A. C. Panton, of Portland, Oreg. Apropos of Mr. Barrows's paper on the same species, in Bulletin 9 of this series, the following abstract is given:

"Today I sent you some small beetles, which are rare in this country, but which I have never seen anywhere else; and it has occurred to me that they might be new

to you. Their most striking peculiarity to the ordinary observer is the extremely offensive odor they emit, especially when crushed. This perfume is simply unbearable, that of the skunk being peaches and cream in comparison. I have met with these beetles only three times in a residence of fifteen years in this country. The first time one of them flew into my face at night and I crushed it with my hand, with the effect of getting some of the fumes into my eye, where it set up a distressing irritation. One can not wash the smell from his hands."

Voracity of Hippodamia glacialis.—Mrs. W. H. Pinney, of Springfield, Mass., writes us that she took a tiny larva of *Hippodamia glacialis*, placed it in a jelly glass and fed it on the larvæ of the elm-leaf beetle. Before transforming it devoured 71 of these larvæ. Mrs. Pinney found it to be an important enemy of the elm leaf-beetle during the summer of 1897.

Injury to chrysanthemums by Corythuca irrorata.—On June 20, 1897, specimens were received at this office of the little tingitid bug *Corythuca irrorata* Riley, from the Florists' Exchange, of New York City, with the information that the species was infesting chrysanthemum leaves. These insects were received from a grower in Alabama, who stated that they attacked the underside of the leaves, causing them to turn brown and die. Kerosene emulsion and tobacco had been used against the pest, but the correspondent wrote that "they just sit up and call for more." The correspondent was advised to give them more.

A Psyllid (Trioza diospyri) injuring Chinese persimmons.—Mr. Thomas G. Fulkerson writes from Tazewell, Tenn., August 6, 1897, that the little Psyllid (*Trioza diospyri*), specimens of which he sent, crumples and rolls the leaves of Chinese persimmons, but does not affect the native persimmons 15 feet away.

Plant-lice injury to tomato.—Dr. T. P. Phelps writes, under date of June 13, from Mount Holly, Md., that a species of plant louse is doing great injury to early tomatoes upon his place. Our correspondent sent specimens which prove to belong to the genus Siphonophora and agree with Thompson's description of *Erigeronensis*, and stated that unless something were done in a remedial way his crop would be ruined. The same species occurs on tomato in the District of Columbia on the grounds of the Department of Agriculture and elsewhere, but we have no record of damage by it.

Parasites of goats.—During September, 1897, specimens were received from the Angora ranch of H. T. Fuchs, at Tiger Mill, Tex., of the goat louse, *Trichodectes limbatus* Gerv. These lice were in a sample of mohair, and were somewhat troublesome on the Angora goats.

Specimens of another parasite of Angora goats were received during the same month from Mr. Charles P. Lounsbury, Cape Town, Cape of Good Hope, South Africa, which were identified by Prof. Herbert Osborn as *Haematopinus stenopsis*.

November 5 we received from Mr. Frank M. Jones, of Wilmington, Del., specimens of *Trichodectes climax* Nitzsch, clipped from a Chinese goatskin, which bore evidence, as our correspondent writes, of the presence and abundance of goat lice in China.

The house crab spider as a destroyer of flies.—A correspondent at Riesel, Tex., Mr. W. E. Sherrill, writes, under date of July 19, that the little house spider known as *Philodromus vulgaris* Hentz, has a practically exclusive diet of house flies. He has taken the trouble to pick up the flies killed by this spider, and writes that the first week 106 were gathered, the second week 76, and the third week 94, and that one day, when flies seemed to be more plentiful than usual, the spider captured 27.

A wasp parasite.—Dr. A. Oemler has sent specimens of the interesting tachina fly, *Pachyophthalmus floridensis*, which his daughter observed attempting to oviposit upon the common mud-dauber wasp, *Pelopœus cementarius*. This fly has previously been reared by Mr. Webster in Ohio, and also by Dr. Davidson in California; by the former from the nests of Trypoxylon, and by the latter from the nests of Sphex. The interesting point is, following the observation of Miss Oemler: Does the fly usually lay its eggs upon the wasp, and are they carried by the wasp to the nest?

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